Knowledge.

With which is incorporated Hardwicke's Science Gossip, and the Illustrated Scientific News

A Monthly Record of Science.

Conducted by Wilfred Mark Webb, F.L.S., and E. S. Grew, M.A.

OCTOBER, 1914.

STEREOSCOPIC DRAWING.

By CHARLES E. BENHAM.

If a test were required for the accurate workmanship of a student in mechanical drawing, no better one could be devised than to set him the task of representing an object in perspective as seen by the right and left eye respectively. The two drawings, when placed in the stereoscope, should show a perfect effect of solidity; but the slightest deviation from exactness in either drawing would manifest itself in the stereoscope very distinctly, and there are few amateurs whose first attempt would not be a failure.

By care and practice, however, very good results may be obtained; and for many scientific diagrams, in which a three-dimensional representation is necessary, stereograms are very useful, and may be substituted with advantage for clumsy models. As examples may be mentioned the forms of crystals, the imaginary planes that have to be explained to students of perspective, the diagrams required to illustrate the polarisation of light, reflection, refraction, and other branches of optics, or, for speculative students, the mysteries of the hypercube.

A difficulty occurs in the limited field allowed by the refracting stereoscope. This necessitates rather small drawing, and, as the lenses of the instrument magnify, the smallest errors are unpleasantly enlarged. Moreover, to avoid distortion, it is desirable that a perspective drawing should come within a horizontal angle of sixty degrees, and a vertical angle of not more than forty-five degrees, which, again, seriously limits the scope of the drawing.

It would be better undoubtedly to construct a special stereoscope with plane prisms allowing of an extensive distant unmagnified field; and, though such an instrument would have to be rather a bulky affair, it would answer the purpose much better for the exhibition of hand-work, and would enable the draughtsman to make his drawings on a less diminutive scale.

Another way is to draw large and reduce by photography to stereoscopic dimensions. With intricate diagrams this is much the best way, and very beautiful results can be produced.

The red-and-green-spectacle method of stereoscopic representation is another way out of the difficulty. The two drawings, which may then be of any size, are drawn (almost superposed), the one in green ink, the other in red. Two gelatine films, stained respectively with the same red and green inks, are used for the spectacles, and the figure is seen like a solid wire model in front of the paper. The process, however, is imperfect. With the red gelatine complete extinction of the red lines is easily obtained, but the green lines always show faintly through the green film, unless the dye is so dense as to obscure vision, or unless the colour-screen is a liquid one, which is obviously inconvenient, though extremely perfect in its effects.

The actual method of drawing for the stereoscope is very simple, extreme accuracy being the main essential of success.

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Bearing in mind the prescribed limitations of size and angle of vision to which reference has already been made, the object is first drawn in perspective in the ordinary way. Take, as a simple illustration, a cube. The perspective representation is drawn as on the left in Figure 336. Pencil lines are drawn horizontally from each determining point of the figure, as shown by the dotted lines in the illustration. These are guides for the position of the corresponding points in the right-hand figure. By this means no measuring point is required for the second drawing, as it is obvious that all these corresponding points must lie in a horizontal line with those of the first figure. The right-hand drawing is placed two and a half inches to the right on the picture-plane, the point of sight being moved an additional half-inch, that is, three inches to the right of the original point of sight.

The limits of stereoscopic separation range between two and a half inches and nearly three inches, so that if the vanishing points are separated by three inches, and the nearest points of the drawing by two and a half inches, the whole picture will be seen comfortably without strain. Even a separation of three inches is too wide for some people; but, as the vanishing points themselves do not figure in the finished drawing, it is safe to give them that amount of separation; for probably no part of the actual drawings will be more than about two and three-quarter inches apart.

It will be seen from Figure 336 that by drawing the receding lines to the new vanishing point for the right-hand figure they will be measured off by the horizontal lines. If an angular or oblique vanishing point enters into the left-hand drawing, it must similarly be moved on three inches for the right-hand drawing.

Accuracy is best ensured by pricking the paper with a fine needle at each determining point that is established, and then drawing to these needle-pricks.

Having completed the drawing in pencil, test it, without removing the construction lines, by examination in the stereoscope. If it is true, the whole may then be carefully ruled in with ink. If the stereoscope reveals faults, the lines should be carefully revised and corrected in pencil until they are right.

It is a good plan, instead of inking over the original, to mount it, when all the determining points are quite accurately placed, over a piece of blank paper on a drawing-board, and with a fine needle, mounted in a handle, prick through all the holes, so as to stencil the whole key to the diagram on the lower sheet. Two sheets or more at a time may thus be stencilled, taking great care that the needle-holes are made absolutely vertically. Join up the points on the stencils in ink with a ruling pen, and each will give a complete stereogram.

If the work of preparing the drawings is considered too tedious and troublesome, the services of a professional draughtsman may be engaged; and, by providing him with plan and elevation, and such instructions as are given above, he will produce results much more perfect than those to which the unpractised amateur can attain without repeated trials and failures. Figures 340–343 accompanying this article were drawn in this way by Mr. Duncan W. Clark, A.R.I.B.A., of Colchester, and are good examples of professional accuracy.

Figures 337–339 are specimens of an instructive series illustrating principles of perspective.

Figure 340 represents the principle of the rainbow, and makes it clear how the refracted rays from all parts of any colour band all form the same angle with a line from the Sun to the spectator; a fact which is often puzzling to students.

Figures 341 and 342 represent respectively the law of inverse squares and the principle of the pinhole camera.

Figure 343 is a diagram to illustrate the laws of reflection of elastic bodies.

Figures 344 and 345 are from a series of polarisation diagrams, and show special cases in which the stereoscopic method takes the place of models.

METEORS.

By W. F. DENNING.

ON Sunday night, August 16th, the sky cleared beautifully, and the stars shone with exceptional lustre.

Meteors were rather frequent, and I observed two very definite and distinct showers in activity, viz., one formed of late Perseids with a radiant at 56°+59°, and another of Lyrids with a radiant at 279°+45°, a few degrees north of Vega. Eight meteors sprang from each of these points.

The Lyrids were also active on August 12th: they are usually swift, bluish-white meteors, rather difficult to record accurately, but often very brilliant and conspicuous.

A bright attractive meteor fell from this radiant at 11.58 on August 16th, with a very slow apparent motion. It descended vertically to my eastern horizon, and I have very rarely traced a meteor so low. It must have been moving from west to east, and probably passed over the region of Ostend, Belgium. The nucleus threw off flakes of fire, and it probably formed a grand spectacle as observed from the North Sea and eastern counties of England. The meteor was also observed by M. E. I. Gheury from Eltham Park, and he says it descended vertically to his eastern horizon, where it burst. From a calculation I have made I believe the meteor must have been less than twelve miles high when it disappeared somewhere about twenty-five miles north of Ostend.

Many brilliant Perseids were observed on the nights from August 10th to 14th. The best were on August 12th, 8h 50m and 10h 33m, and August 14th at 9h 34m. A fireball from a radiant in the north-western region of Aquila appeared on August 14th, 9h 50m. It passed over the north coast of France, near Boulogne, and fell from a height of sixty-seven to forty-four miles, with a velocity of sixteen miles per second. BRISTOL.

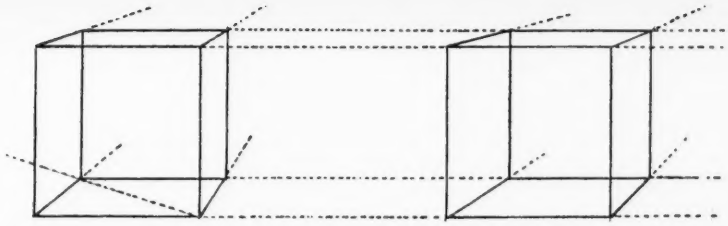

FIGURE 336. Showing method of stereoscopic drawing. The dotted lines represent the pencilled construction lines.

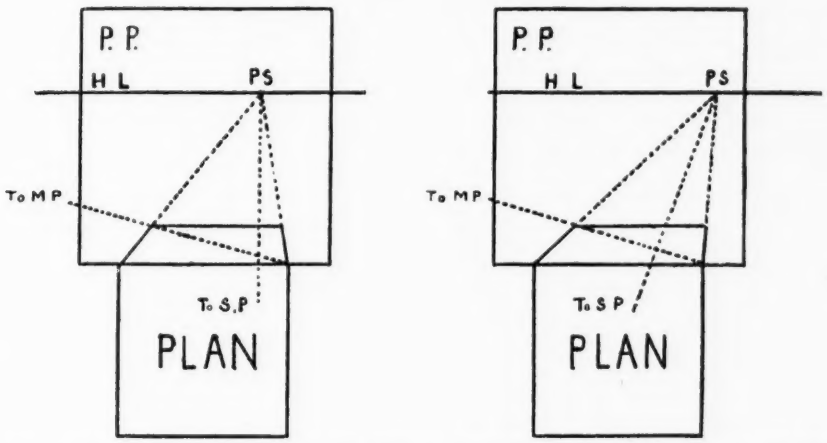

FIGURE 337. The left-hand figure shows the ordinary perspective paper as figured in the text books. How the diagram should be thought of by the student is revealed by the stereoscopic view.

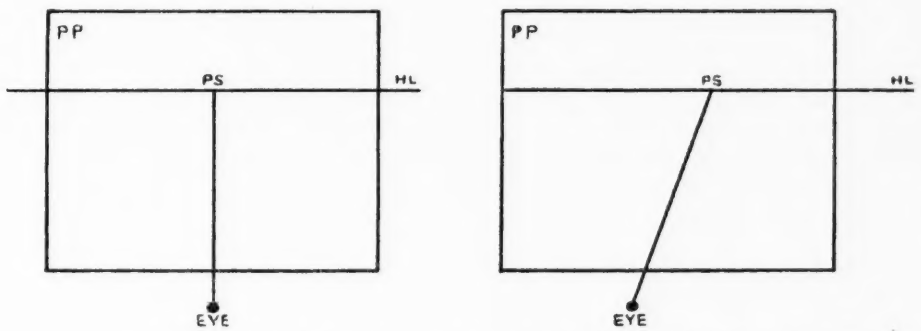

FIGURE 338. Another perspective diagram showing the relative positions in which the horizon line picture plane and station point ought to be regarded.

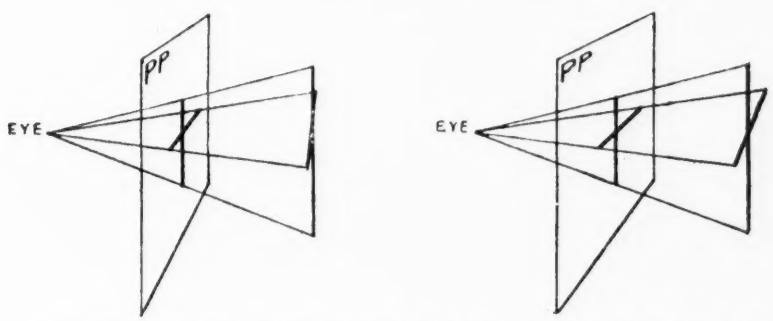

FIGURE 339. Diagram showing how the image of an object is formed on the picture plane by lines drawn from all points of the object to the eye.

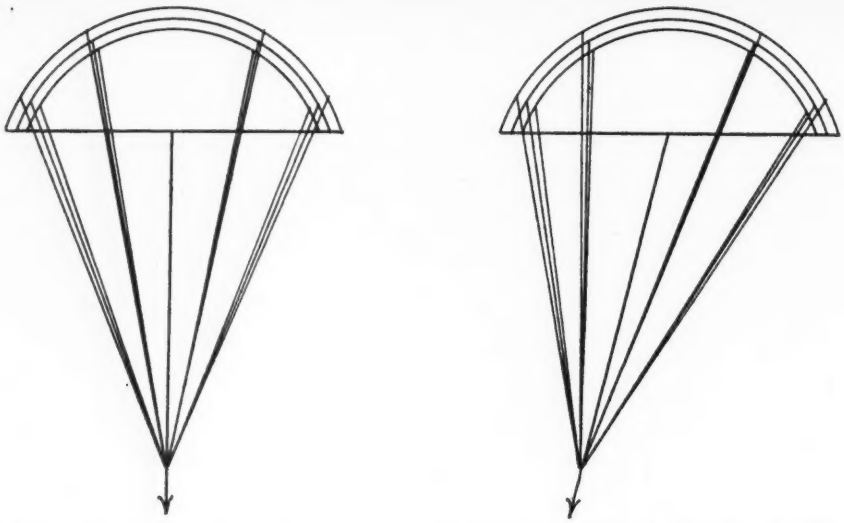

FIGURE 340. The rainbow. A line is shown which if produced would pass through the spectator to the Sun. It will be seen in the stereoscope how the refracted rays form an angle with this line on all sides. The original of this diagram is in colours, making it all the more instructive.

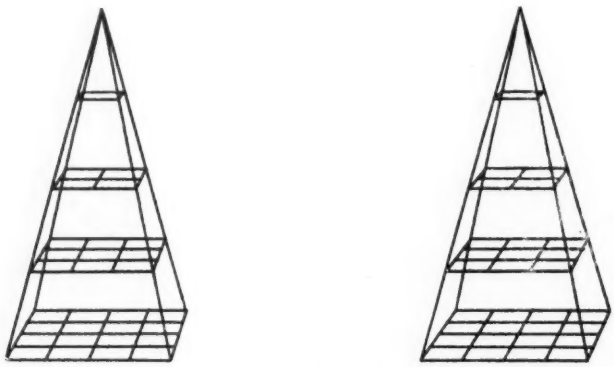

FIGURE 341. The law of inverse squares.

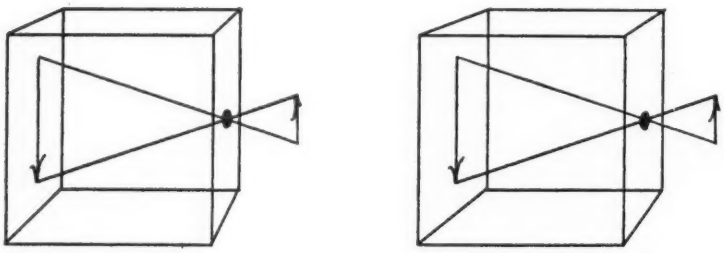

FIGURE 342. The Pinhole Camera, illustrating the formation of the inverted image.

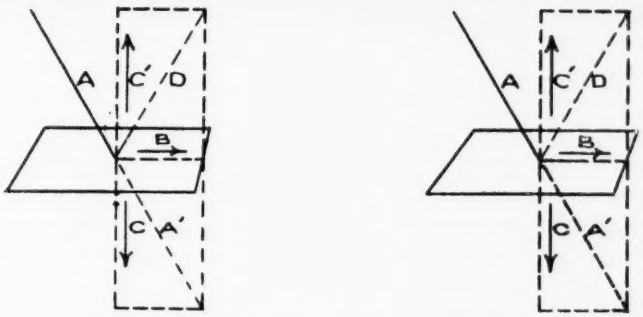

FIGURE 343. Reflection of Elastic Bodies. Diagram showing how the principle of the parallelogram of forces explains the angle of reflection.

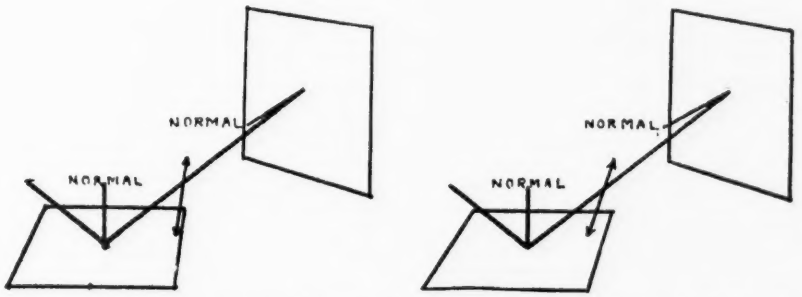

FIGURE 344. Polarised Ray reflected from a horizontal plate, but unreflected from a vertical plate when incident upon it at the same angle with the normal, viz., 54½ degrees.

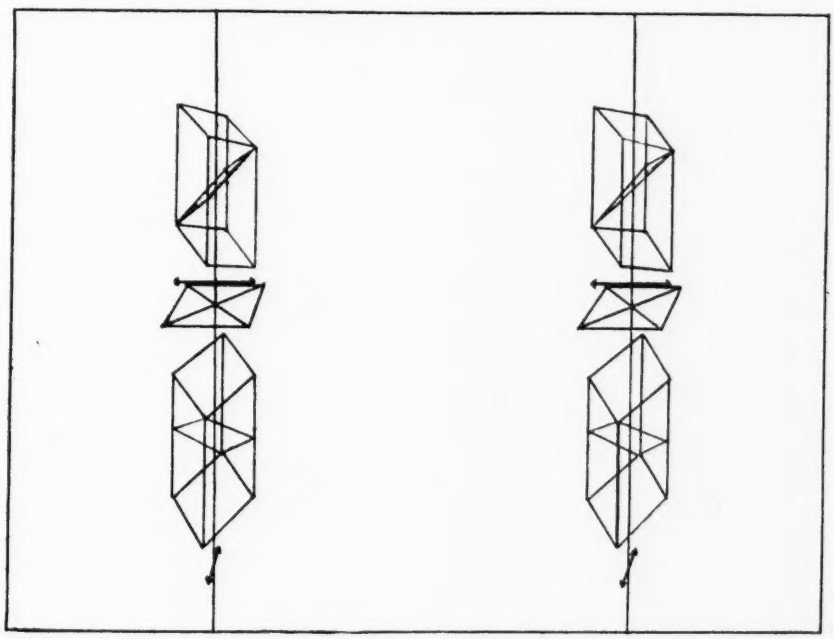

FIGURE 345. Diagram showing the Change of Plane effected in a ray in passing through a nicol prism; secondly, through a film of selenite; and, lastly, through a second nicol.

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FIGURE 346. Crescent-shaped images of the Sun seen under trees during the maximum phase.

FIGURE 348. Maximum phase in 1914.

FIGURE 347. Equatorial telescope arranged for projecting the image.

FIGURE 349. Maximum phase in 1912.

THE SOLAR ECLIPSE OF AUGUST 21ST, 1914,

VIEWED IN ITS PARTIAL PHASE FROM HAMPSTEAD.

By W. ALFRED PARR, F.R.A.S.

OBSERVERS who had gone abroad to view the recent solar eclipse in its total phase were little to be envied in these turbulent times. Now that Europe has let slip the dogs of war in deadly earnest, the partial phase, as seen at home, acquired an interest and popularity out of all proportion to its intrinsic merits, which were small. In London, at the moment of greatest phase, some sixty-five hundredths only of the Sun's disc were hidden by the Moon, as against about ninety-two hundredths during the eclipse of 1912. Yet the recent eclipse—regarded as a spectacle—had one great advantage over that of two years ago. This advantage lay in the fact that a large spot existed on the Sun's surface, which constituted a point of considerable interest when the Moon's limb crossed it in transit. The spot was plainly visible to the naked eye, and I found it a fairly conspicuous object as the Sun set behind a bank of haze over Hampstead Heath on Wednesday evening, August 19th.

The observations of partial solar eclipses contribute doubtless in but a small degree to the advancement of astronomy in general; but they are always interesting from a spectacular point of view, and may, in certain circumstances, even yield valuable results to the spectroscopist. This was ably pointed out by Professor Fowler in the *Monthly Notices* of the Royal Astronomical Society* on the occasion of the 1912 eclipse, when, using a six-inch equatorial in conjunction with an Evershed spectroscope, he succeeded for about a quarter of an hour on either side of mid-eclipse in observing hundreds of the Fraunhofer lines brightly reversed. He adds that the appearance of the spectrum strongly recalled that of the flash spectrum photographed during total eclipses, and concludes his paper by expressing the opinion that "partial eclipses, and the partial phases of total and annular eclipses, might be utilised for spectroscopic observations to a much greater extent than has hitherto been the case." It is true that Professor Fowler's highly stimulating results were obtained when the magnitude of the eclipse ranged from 0·8 to 0·9. Under these conditions the extent of the projection of the chromosphere beyond the solar cusps would be considerably greater than its radial depth, which is generally taken to be from five to six thousand miles, this latter, of course, being the maximum amount ordinarily available for spectroscopic examination without an eclipse.

But when, during the partial phase of an eclipse, the advancing dark body of the Moon shuts out the light coming from the solar photosphere, there is a point at the solar cusps where chromospheric light can be studied with an advantage which varies in proportion to the magnitude of the phase. This advantage begins to make itself felt as soon

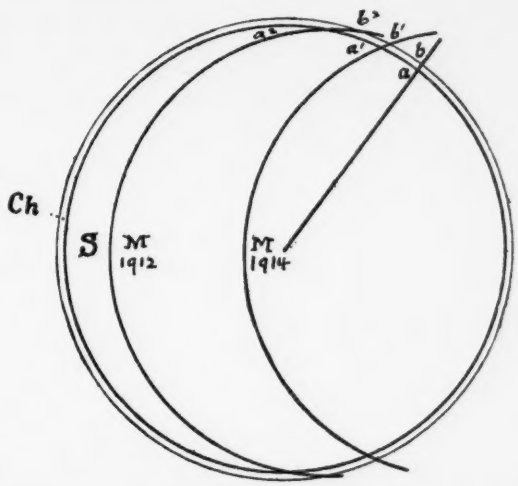

FIGURE 350.

as the angles at the cusps become less than ninety degrees. Thus the conditions in 1912, when the maximum phase amounted to 0·92, were favourable; but during the recent eclipse the phase never amounted to more than 0·65—as seen from London, at least—and the possibility of obtaining a view of the unobstructed chromospheric spectrum was correspondingly diminished. This will readily be understood on referring to Figure 350, where, for the sake of clearness, the depth of the chromosphere has been exaggerated. If S be allowed to represent the Sun, surrounded by the chromospheric layer Ch, then the short distance $a\,b$ would represent the radial depth of the latter, as seen without the aid of an eclipse. The longer distance $a^1\,b^1$ would show the extent of the chromosphere projecting beyond the solar cusp at the moment when the Moon's limb occupied the position M 1914, as during the maximum phase of the recent eclipse; while the still greater distance, $a^2\,b^2$, would represent the very favourable conditions obtaining during the

* See *Monthly Notices*, R.A.S., Volume LXXII, No. 7, page 538.

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maximum phase of the 1912 eclipse, when, thanks to the magnitude of the phase, a considerable amount of comparatively pure chromospheric light was made available for the spectroscope.

On comparing the photograph of the projected image of the 1914 eclipse (see Figure 348) with that of the 1912 eclipse (see Figure 349) the actual conditions obtaining at both become strikingly apparent. The photographs—unfortunately not on the same scale—were taken at the moment of maximum phase in each case in order to secure a rough record of the two events. Figure 347 shows the means adopted for projecting the image, and a few seconds only were necessary to remove this after the maximum phase had been photographed.

But, in spite of this year's unfavourable conditions and the meagreness of my instrumental equipment, which consisted merely of a three-and-a-half-inch refractor, used in conjunction with a small direct-vision grating spectroscope, I made an attempt to catch a glimpse of the flash spectrum. Fortunately my instrument, though small, was equatorially mounted and clock-driven, so that, by simply rotating the spectroscope, I was able to keep the slit fairly up to the solar cusp. Working in this way, I certainly noticed that many of the bright Fraunhofer lines were easily observable, especially in the neighbourhood of D and E; but, beyond the fact that these lines were more readily reversed bright than is usually the case, I am unable to speak with certainty in the matter, as my small spectroscope offered no handy means of identifying them.

I found some compensation, however, in the beautiful spectrum of the great spot, where the increased absorption over umbra and penumbra was very noticeable in the marked accentuation of the lines.

After obtaining the maximum phase record shown in Figure 348, and searching spectroscopically in the above-described manner for the bright reversal of the Fraunhofer lines, the remaining moments of the eclipse were devoted to direct visual observations, made with the aid of a sun-prism and dark-wedge eyepiece magnifying some eighty diameters. Of these observations the most interesting was the transit by the Moon's limb of the great spot. The transit across the outer margins of the penumbra was accomplished in a little over three minutes, and it was instructive to note the intense blackness of the lunar limb when in close proximity to the umbra of the spot, which appeared dark grey in comparison, while the Moon's limb itself showed marked irregularities, especially towards the south.

Of meteorological changes there is little to record. A self-registering thermometer exposed to the Sun's rays throughout the eclipse showed a fall of temperature amounting to some twelve degrees a little after mid-eclipse. Standing at ninety-four degrees at the commencement, it fell to eighty-two degrees at 12.30 p.m., and rose to ninety-four degrees again by 1.40 p.m., nineteen minutes after the end of the eclipse. But it should be stated that cloud came up for a very short spell about midday. At the moment of greatest phase, however, viz., at 12.11 p.m., the sky was perfectly clear again. At the 1912 eclipse the same thermometer, exposed under identical conditions, recorded a fall of twenty-two degrees, the minimum temperature again occurring about ten minutes after mid-eclipse.

The diminution in sky illumination, so marked at the previous eclipse, was scarcely noticeable this time—a fact which is well brought out on comparing Figures 348 and 349. In Figure 349 the Sun appears as a thin bright crescent, but in Figure 348 it is plain that the general sky light is sufficiently powerful to render the image of the solar crescent, as projected upon the screen, comparatively faint.

Another interesting feature, well shown in Figure 348, is the general darkening of the solar disc towards the limb, caused by the light-absorption of the Sun's smoke-laden atmosphere. This darkening here appears in its usual telescopic aspect, and not with the exaggerated effect seen in direct photographs of the Sun, where the redder, and consequently less actinic, rays transmitted to us by the increased selective absorption going on at the limb produce an undue effect of contrast on the photographic plate.

The crescent-shaped images of the Sun seen under trees during the maximum phase were duly noted (see Figure 346).

GIZA ZOÖLOGICAL GARDENS.

From the fifteenth annual report of the Giza Zoölogical Gardens we learn that in the year 1898 the collection at the date of annual stocktaking consisted of two hundred and seventy specimens of ninety-eight forms, while in 1913, to which the report refers, there were one thousand six hundred and thirty specimens, illustrating three hundred and seventy-eight species. Among the animals born in the gardens were five Hyraces, a Sabre-horned Antelope, a Princess Beatrice Antelope, an Addax Antelope, two Kordofan Kudu Antelopes, and two Kordofan Giraffes. The report concludes with notes on the protection of the Egyptian fauna, from which we gather that, although it was only as recently as May, 1912, that the laws regarding shooting licences and the protection of birds useful to agriculture were made, results are most encouraging. The success in protecting the Cattle Egrets has so far exceeded the most sanguine expectations. Considerably over a thousand birds were hatched and reared during 1913. Reports from various provinces mention that the birds have appeared in the fields of villages where they had not been seen for ten or twelve years. Only one case of Egrets illegally taken has been reported, and that proved to have had the well-meant intention of founding a fresh colony in a province in which these birds have become extinct.

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FLORA SELBORNIENSIS.

WITH SOME COINCIDENCES OF THE COMING AND DEPARTURE OF BIRDS OF PASSAGE AND INSECTS, AND THE APPEARING OF REPTILES, FOR THE YEAR 1766.*

UNDER the title of " A Garden Kalendar " Gilbert White for sixteen years kept a diary of the operations and interesting occurrences which took place in his garden. Towards the end of this period, which extended from 1751 to 1767, his scientific interest in wild plants increased; and, having bought a copy of Hudson's " Flora Anglica " in 1765, " The Garden Kalendar," thenceforth spelt with a " C " from August onwards, began to contain entries of a botanical nature. In the following year (1766), instead of being inserted in the " Garden Calendar," the Natural History Notes were separated, and kept in a special diary called the " Flora Selborniensis," with a second title, " The Calendar of Flora." This was the forerunner of " The Naturalist's Journal," begun in 1768, and continued by Gilbert White until his death in 1793.

The first serious attempt of the author of " The Natural History of Selborne " to record his observations in the subject which made him famous, has a very special interest, and it is intended to reproduce facsimiles of the pages of the " Flora Selborniensis," and to publish some notes with regard to the various entries, beginning with the month of October.

OCTOBER, 10TH MONTH.

1. It will be noted that Gilbert White nearly always uses pre-Linnean names—which are practically short descriptions—for his plants, while for birds, binomials are given.

   Here he recognises that *Caucalis arvensis* is very near to *C. anthriscus*, which Bentham and Hooker say is often mistaken for it.

   In " A Naturalist's Calendar," extracted by J. Aikin from Gilbert White's " Naturalist's Journal " for the years 1768–1793, the date of the earliest appearance of the Woodcock (*Scolopax rusticula*) is given as September 29th, and the latest November 11th. As a great many more Woodcocks now nest in the British Isles, it is not so easy to fix the date of the earliest arrival. As a rule, foreign Woodcocks do not come till the middle of October.

5. One day earlier and one month later are the extreme dates given in " A Naturalist's Calendar." Very much later ones have been recorded, namely, the end of November and the beginning of December. For the precise dates see *The Zoologist*, 1881, page 62, and articles on " Swallows in Winter " (*The Field*, January 22nd, 1887) and " Belated Swallows " (*The Field*, January 30th, 1892).

   Gossamer is given as appearing from October 15th to 27th.

10. The Guernsey Lily (*Nerine sarniensis*) belongs to the Amaryllidaceae, and is really an exotic, coming originally from South Africa. Spurrey (*Spergula arvensis*) flowers throughout the summer. Presumably the entry is made as indicating the lateness of the occurrence.

13. This is a late date for the Woodlark (*Lullula arborea*) to be singing. Probably the weather was mild. The Hedge Sparrow (*Accentor modularis*), like the Wren (see below), may often be heard in winter.

14. The Strawberry-tree (*Arbutus Unedo*) is put down in " A Naturalist's Calendar " as flowering on October 1st.

17. Taking Selborne as being two hundred feet above sea level, a barometer reading of 30·0 would correspond to a sea-level pressure of 30·63. Mr. William Marriott has kindly supplied the following records: 31·007 on February 24th, 1808, at Gordon Castle, Banff; 31·108 on January 9th, 1896, at Ochtertyre; 31·110 on January 31st, 1902, at Aberdeen; 31·097 on January 28th, 1905, at Falmouth.

    The Common Snake is now called *Tropidonotus natrix*, and the Blindworm *Anguis fragilis*. The Drone Fly (*Eristalis tenax*) is easily recognised from the entry.

    It is not so easy to identify the second fly from Ray's description, but in Linnaeus's copy of " Historia Insectorum " the name *M. pellucens* is written on the margin. This species, Mr. F. W. Edwards tells me, is now *Volucella pellucens* L. (" Syst. Nat.," Ed. 12, Vol. 1, page 989). As neither Mr. Edwards nor other collectors to whom he has spoken have noticed that the fly smells of musk, while there is no statement in the literature of the subject to this effect, it seems likely that Gilbert White's *Musca moschata* is not *Volucella pellucens*. Moreover, his observation that

* The Plants are according to Mr. Ray's method; the Birds according to Mr. Willughby's ornithology; the Insects according to Ray's " Hist: Insect: " and the Reptiles according to Ray's " Synopsis Animalium Quadrupedum."

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October 10th month. 57.

1. Small corn-parsley, Caucalis segetum minor, anthrisco hispido similis, blows, & seeds.
4. The first great rain
My late garden-asters, & golden-rods begin to flower.
1. The wood-cock, scolopax, returns.
5. Swallows, & martins gone.
Rooks steal the wallnuts from off trees.
Spiders webs appear.
10. The Guernsey-lilly, Amarillis spathâ multiflorâ, corollis æqualibus patentissimis revolutis, genitalibus longissimis, blows.
Spurrey, spergula, flowers.
12. White frost, & Ice.
13. Apples, & pears are gathering.
Woodlark sings.
Provence, & monthly roses blow.
The hedge-sparrow, curruca, pipes in the morning.
14. Strawberry-tree, Arbutus, blows.
White frost, & Ice.
The buck, dama, grunts, & goes to rut.
17. Barometer is very high at 30 inch: & 4 10ths

58. Octob^{r} 17. Black cluster-grapes are delicate.
Common snake, natrix torquata, still appears.
The blind-worm, or slow-worm, Caecilia, is seen.
Cathins of the alder, alnus, are formed:
The cones are full of seed.
Musca apiformis, tota fusca, caudâ obtusâ, ex eulâ caudatâ in latrinis degente orta, still is seen. This fly frequents sinks, & jakes, where it lays it's eggs. In the autumn it feeds on the flowers of late annuals, & perennials; & in particular on the blossoms of Ivy. Ray hist: Insect: 278.
Musca bipennis major, diversicolor, caudâ setis nigris obsitâ [illegible] appears, & engenders. This fly is entirely a garden or field fly, never entring into houses: it appears to feed on mellow fruit. M^{r} Ray seems not to have been aware that it smells strongly of musk: it might therefore not improperly be call'd musca moschata. 271.
This seems to be an autumn fly altogether.
20. Common wild service-tree, or Sorb, Mespilus apii folio sylvestris non spinosa, seu Sorbus torminalis, in fruit; but it is hard, & austere still.
21. Wheat springs out of the Ground.
22. The fieldfare, turdus pilaris, returns.

59.

Octob.r 22. The glow-worm, cicindela, appears, & shines faintly.
23. Mulberry-tree is naked.
Rooks carry off the acorns from the Oaks.
The Scotch pine casts it's leaves of last Year.
Walnut-tree is naked.
24. Plants naturally in bloom still:
Laurustine, Ivy, arbutus, great & less throat-wort, round-leaved Campanula, burnet-saxifrage, Hawkweeds several, round-leaved, & sharp-pointed, fleabin, blue Devil's bit, knapweed, wild thyme, herb Robert, groundsel, hop-trefoil, soap-wort, yarrow, creeping tormentil, dwarf-cistus, cha: mòmile, great basil, mallow, red pimpernel, small stitchwort, viper's bugloss, milkwort, dandelion, wild marjoram, white horehound, creeping mouse-ear, plowman's spikenard, cat mint, many foreign perennial asters, spotted arsmart, ragwort, marsh thistle, shepherd's purse, pansies, sweet-scented reseda

Plants continued in bloom by accidents, such as a shady situation, the bite of Cattle, &c:
Mullein, wild angelica, daucus, spear-leaved thistle, musk D.o Sow-thistle, corn-marigold,

60. sparrey, red & white clover, crow foot several sorts, stinking may-weed, hedge-nettle, charlock, small field-madder, woody night-shade, thorney apple, white dead-nettle, balm, corn-poppy, yellow Ladies-bedstraw, betony, meadow-saxifrage, violet common, mouse-ear scorpion-grass, water Do: wild buglos, borage, white campion, common daisey.

Octob: 28. The Red-wing, swine-pipe, or wind-thrush, turdus iliacus, appears.

Novem: 4. H: Mouth.

Most delicate seed-time. Wheat comes up well. The fruiting-Ananas are ranged in their beds to stand the winter: fires begin to be lighted in the stoves.

6. The dragon-fly, libella, appears still. Ice. The musk-fly, & many field-flies bask in the sun on the trunks of trees. Bee-flies feed on the blossoms of perennials.

Barometer up at 30 inch: & 4 10ths

7. Snow, & great showers.

10. Lychnidea blows still.

13. The wren, ~~Regulus~~ Troglodytes, whistles.

The Hanger begins to be raked.

Finished dressing the vines.

Heavy showers which make the springs rise.

this is an autumn fly altogether, does not agree with the dates of capture of the specimens in the British Museum, which range from May 21st to September 12th.

20. The Wild Service-tree is now *Pyrus torminalis*. Here Gilbert White uses a Linnean, as well as a pre-Linnean, name.

22. The extreme dates recorded by Gilbert White for the return of the Fieldfare are October 12th and November 23rd. The third week in October is about the usual time for both Fieldfares and Redwings to arrive. If the weather is cold they appear in the second week of that month. The Glow-worm is the beetle, *Lampyris noctiluca*.

24. The Throatworts are *Campanula Trachelium* and *C. glomerata*. Round-leaved Fluellin is a Speedwell (*Veronica officinalis*); Sharp-pointed Fluellin is *Linaria Elatine*; Spotted Arsmart is *Polygonum Persicaria*; Creeping Mouse-ear is a Hawkweed (*Hieracium Pilosella*); Baum is, of course, Balm; Mouse-ear Scorpion-grass is *Myosotis arvensis*; and the water one, the Forget-me-not, *M. palustris*. Mr. F. A. Bellamy, who has for many years made phenological observations, has found the majority of the plants mentioned in flower as late or later than noted by Gilbert White in 1766. With regard to Milkwort, however, he says that he was quite unaware that this plant could be found in flower in October.

28. The Redwing is *Hylocichla iliaca*. October 10th and November 10th are the earliest and latest dates given in "A Naturalist's Calendar." See note under the date October 22nd.

NOVEMBER, 11TH MONTH.

6. See the note with regard to the barometer on October 17th.

10. Lychnidea is the Phlox.

13. The Wren is now called *Anorthura parvula*. See note dated October 15th.

(To be continued.)

THE POLE-LATHE.

By WILFRED MARK WEBB, F.L.S.

FOR some years the present writer has been interested in the rural industries which still survive in a number of our villages. In several instances the very primitive pole-lathe still plays an important part, and wherever it was seen a point was made of securing a photograph.

The first example which came under notice was that belonging to a bowl-turner in Berkshire, which is shown in Figure 353. In this case a strap will be seen, which is fixed to the treadle under the lathe, and passes upwards, taking a turn round the mandrel, or "mamper," on its way to the end of a long, pliable pole above, to which it is attached. When the treadle is pushed down, the mandrel is caused to revolve, and the pole is bent. When the pressure of the foot is released, the pole flies back and causes the mandrel again to revolve, but in the opposite direction. There is not, therefore, a continuous rotary motion in one direction, as in the modern lathe, and this has its advantages, as will be noticed in Figure 351. In this the bowl-turner is seen at work on a wooden bowl with a handle which could not possibly be produced by machinery that is continuously turning the work in the same direction.

The bowl-turner's lathe was fixed in a shed on a common in front of the owner's cottage, but the most simple form of lathe is that which is moved from place to place in the Buckinghamshire woods, and sheltered by a temporary hut, as shown in Figure 352. Here the pole is fastened to a post outside the hut, and carried in through a hole in the screen, over a beam which supports it. These lathes are used for making chair legs, and differ from that used by the bowl-turner in that the cord from pole to treadle passes round the actual piece of work which is being turned. This is well seen in Figure 354, which is taken from a lathe in a chair-making works in an Oxfordshire village, close to the borders of Buckinghamshire. The pole in this case is inside the shed, and passes over a beam, as seen in Figure 355.

A very similar arrangement was adopted in a Wiltshire village, where there was a chair-making industry, and a photograph of one of the lathes is given in Figure 357.

In a brush-handle factory in Berkshire steam power has been applied to the majority of the lathes, though they are made of wood, and in general construction are little in advance of the pole-lathe. The latter, however, is still retained, as will be seen from Figure 356, for finishing off the mop-handles.

It will be obvious that just as the Archimedean- or the bow-drill differs from a centre-bit, or a modern drill, so the pole-lathe differs from the ordinary one; and, as the pole-lathe is apparently older than history, it will be interesting to consider its possible development, and to contrast it with other primitive methods of turning which are still in existence.

(To be continued.)

FIGURE 351. Turning a Wooden Bowl with a handle on a Pole Lathe in Berkshire.

FIGURE 352. Movable Huts to shelter Pole Lathes for converting timber into chair-legs, on the spot, in the Buckinghamshire Woods.

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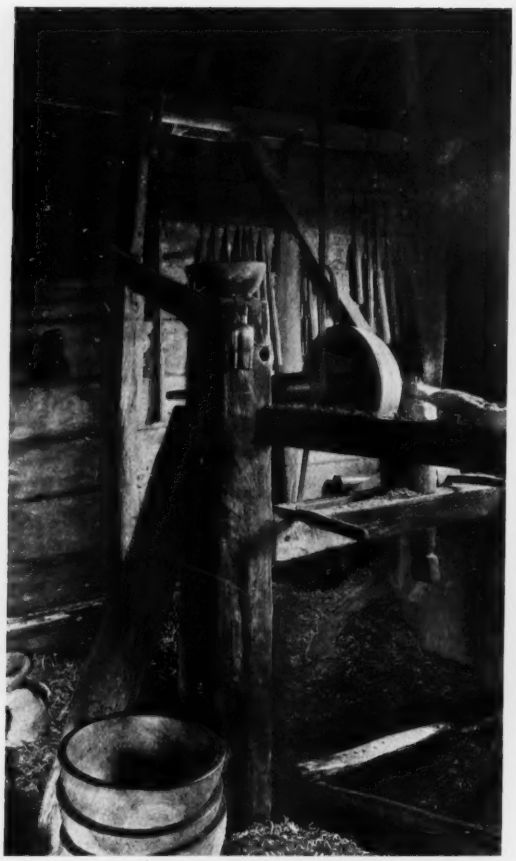

FIGURE 353. General View of the Berkshire Pole Lathe with an ordinary bowl nearly completed.

FIGURE 354. Turning Chair-legs on the Pole Lathe in Oxfordshire.

FIGURE 355. Method of carrying the Pole over a beam in the workshop, Oxfordshire.

FIGURE 356. Finishing off Mop Handles on the Pole Lathe in a brush-making works in Berkshire.

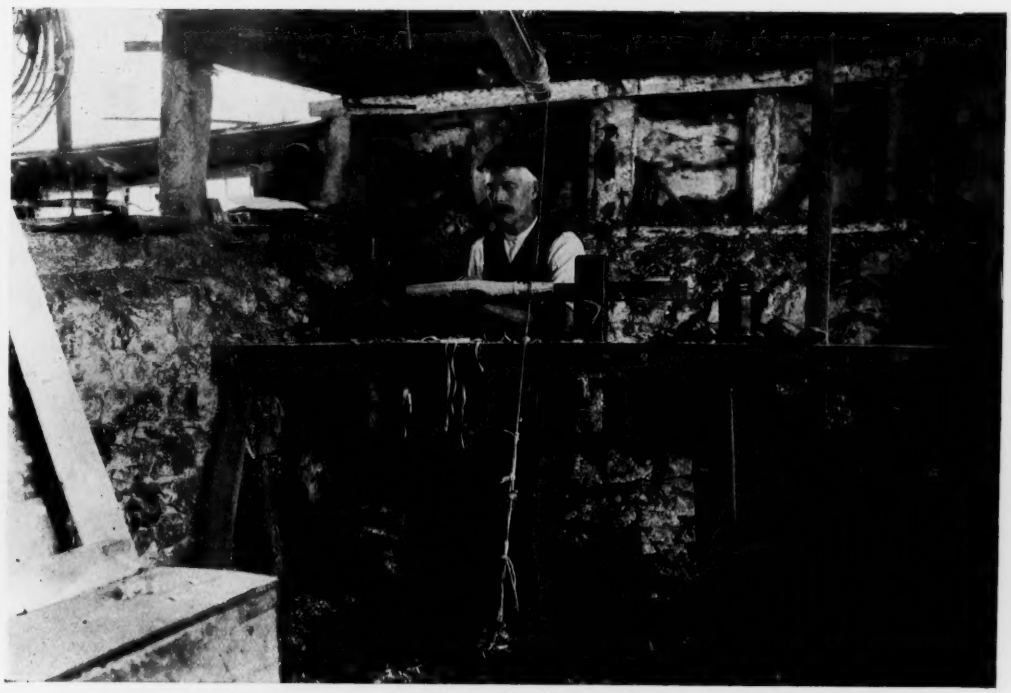

FIGURE 357. Pole Lathe used in Chair-making in Wiltshire.

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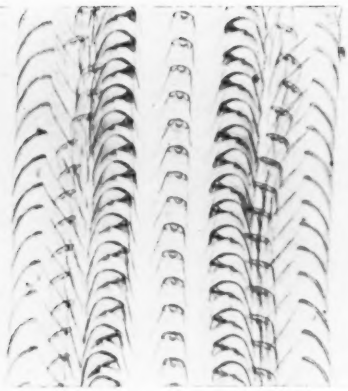

FIGURE 358. The Radula of *Comatias elegans*.
(See page 373.)

The specimen was mounted in euparal.

FIGURE 359. Young Earwig (♀) approaching adult stage. The wings are just beginning to appear. ×14.

FIGURE 360. Callipers or Forceps on the terminal segment of the young Earwig (♀). Note the smooth appearance on the curved inner surfaces. ×24.

FIGURE 361. Callipers of Earwig (♀). ×24.

FIGURE 362. Callipers of Earwig (♂). ×24.

(See page 373.)

NOTES.

ASTRONOMY.

By A. C. D. Crommelin, B.A., D.Sc., F.R.A.S.

THE SOLAR ECLIPSE.—These notes are written before full information has reached me, but it is already obvious that observations have not been entirely frustrated by the war. The Greenwich observers, Messrs. Jones and Davidson, fortunately reached Minsk well before the outbreak of hostilities, and were favoured by fine weather. The Royal Astronomical Society's expedition to Hernosand, Sweden, consisting of Father Cortie, Mr. Atkinson, and others, was also successful: they noted that the coronal type was intermediate between those of minimum and maximum. The coronal spectrum was studied in the longer wave-lengths, while at Minsk the violet end was studied; the two series should therefore supplement each other. Mr. Slater was also in Sweden: his instruments had gone to Riga, but he was unable to follow them. Fortunately he had a four-inch lens with him, and managed to contrive a camera with which some good photographs were taken. This resourcefulness reminds us of Mr. Maskelyne in 1900: his kinematograph failed to turn up at the eclipse, but he improvised another, and obtained successful results. I fear that many observers who sent their instruments to Russia in advance are likely to be deprived of them for a considerable period, but I hope they will eventually be restored. The partial eclipse was well seen in England. The presence of a large sunspot, which was hidden by the Moon, added interest. At Greenwich, for the second time within two and a half years, a meridian observation was obtained of the Moon on the Sun's face. There will not be another meridian eclipse at Greenwich till 1929, but the transit of Mercury on November 7th will take place on the meridian. The next two total solar eclipses are both in accessible regions, viz.: 1916, February, north coast of South America and Guadaloupe; and 1918, June, right across the United States.

PROFESSOR KAPTEYN ON THE DISTANCE OF THE GALACTIC HELIUM STARS.—Professor Kapteyn's papers on the structure of the stellar universe are always worthy of attention, and the one which appears in *The Astrophysical Journal* for July is no exception. It deals with helium stars brighter than the sixth magnitude within 30° of the Galaxy, and between 216° and 360° galactic longitude. Most of the stars in question appear to be moving on almost parallel paths; and, if we assume this as being true of their absolute motion in space, we can deduce the parallax from the observed proper motion and radial motion. Boss's proper motions are used. His General Catalogue contains seven hundred and fifty-two helium stars, of which three hundred and nineteen are discussed in this paper. The stream velocity is determined as 18·3 kilometres per second, and the probable departure of individual stars from the stream velocity is 2·1 kilometres. The observed radial velocities of helium stars are found to require a systematic correction of −4·3 kilometres. The reason is unknown, but the fact has been verified by several people. A map is given of the arrangement in space of the stars considered, projected on the galactic plane. The plotted distances vary from one hundred to one thousand two hundred light-years, there being a decided cluster at a distance of three hundred light-years.

An estimate is given of the distance of the Pleiades, assuming that its motion is parallel to the Galaxy: it comes out one hundred and eighty light-years. Another interesting case discussed is the distance of the Perseus cluster, for which Messrs. Adams and Van Maanen announced last year the high radial velocity of −43 kilometres per second. From four helium stars in the cluster the distance is estimated at four thousand seven hundred light-years, in good accord with Newcomb's estimate of the distance of parts of the Galaxy. Kapteyn thinks it very unlikely that the Perseus cluster is nearer than one thousand five hundred light-years. The Lesser Magellanic Cloud gave the enormous distance of seventy-five thousand light-years. It is noted that Hertzsprung by another method found its distance to be thirty-six thousand light-years. The two estimates are in good agreement, considering the nature of the problem. Both are based on the assumption that there is no absorption of light in space. On the assumption that a star at a distance of thirty-two light-years loses 0·02 magnitude through absorption, then the distance of the Lesser Magellanic Cloud would be eight thousand light-years on Hertzsprung's method.

A further section of Kapteyn's article deals with the relation between distance and colour index. He takes it as established that if two stars have the same apparent magnitude, and the same spectral lines, that further away has the greater colour index. As a first approximation he takes the law

$$\text{Colour index} = g + C \times \text{distance},$$

where g, C are constants, of which g depends on the spectral class, and is already known from the stars near our system. If C can be found, the above equation will give the distance. Professor Kapteyn hopes it may be possible to evaluate it with the aid of a list of parallaxes of distant objects deduced by his own or Hertzsprung's method.

The Observatory for September contains some remarks by Professor H. C. Plummer on Professor Kapteyn's article. He had already published in the *Monthly Notices* hypothetical parallaxes for a number of stars of early type deduced by a method similar to that of Kapteyn, and he compares the results of the two investigations. In the majority of cases the parallaxes are of the same order of magnitude, which increases our confidence in their approximate accuracy. In other words, the method has enabled us to estimate with fair accuracy the distances of stars twenty or thirty times as remote as those for which we can directly measure the parallax. Professor Plummer notes that, though the helium stars are spoken of as forming a "stream," it is quite likely that they are in reality almost at rest with respect to the centre of gravity of the stellar system.

DELAVAN'S COMET.—We may expect this comet to be fairly conspicuous during October. It passes perihelion on the 26th, on which day it is 7° north of Arcturus. The following ephemeris (for 11h p.m.) is by Professor G. van Biesbroeck, of Uccle. The elements on which it is based are very accurate.

	R.A.	N. Dec.		R.A.	N. Dec.
	h m s	° ′		h m s	° ′
Oct. 2	12 7 54	43 54	Oct. 22	13 56 0	29 33
,, 6	12 33 42	41 25	,, 26	14 12 0	26 27
,, 10	12 57 18	38 40	,, 30	14 26 36	23 25
,, 14	13 18 48	35 43	Nov. 3	14 40 0	20 29
,, 18	13 38 18	32 49	,, 7	14 52 24	17 41

On October 10th the comet will be near α Canum Venaticum (Cor Caroli); on November 4th near η Boötis. For the greater part of October it will be visible both in the evening and the morning, owing to its being so far north of the Sun.

Professor Barnard writes that on July 28th the comet was easy to the naked eye; in a five-inch telescope a considerable tail was seen, and the nucleus was stellar. A photograph showed a fan-shaped tail 1½° long.

On August 3rd the magnitude was fully 4½. A photograph showed a wide tail with a curious lateral streamer on the north side.

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Observers with cameras should secure numerous photographs of the tail during October. The two great sources of cometary information, the Centralstelle telegrams and the *Astronomische Nachrichten*, have been cut off by the war, so we shall be more dependent than usual on home efforts in finding and following comets.

BOTANY.

By PROFESSOR F. CAVERS, D.Sc., F.L.S.

PLANT INVASION ON HAWAIIAN LAVA FLOWS.—The revegetation of Krakatau, which was deprived of vegetation by a series of volcanic eruptions in 1883, has been followed out by Treub, Ernst, and other observers. A detailed account is given in "The New Flora of the Volcanic Island of Krakatau" (Cambridge University Press, 1908). Successive lava flows from Mauna Loa, in Hawaii, by far the largest volcano in the world, have afforded an opportunity for similar observations there, especially as the age of many of the flows is exactly known. Forbes (*Occ. Papers Mus. Polyn. Ethn. and Nat. Hist.*, Vol. 5) has published a preliminary account of the plant invasion of some of these flows. The lava is of two well-defined kinds, called by the Hawaiians "pahoehoe" and "aa": the former has a smooth, but billowy, or hummocky, surface, and is marked by lines showing that it cooled as it flowed, while the "aa" is lava broken into fragments having sharp and jagged edges, probably owing to subterranean moisture having made it cool from below upward, instead of from above downward, as in the case of the "pahoehoe." On 1859 flow Forbes found no vascular plants on the "aa," though the surface was often white with lichens; while, contrary to what might have been expected, the smooth "pahoehoe" was much more richly covered with vegetation, which, however, occurred only in cracks. On a 1907 flow plants were found just beginning to be established. Evidently on both types of lava the first pioneers are low plants, like algae and lichens; on the "pahoehoe" these are soon succeeded by ferns and seed-plants, but on the "aa" there is a long-enduring lichen stage. Ultimately the natural forest of the region returns, except in places where man's influence causes the successful invasion of a naturalised flora. In this forest a species of *Metrosideros* is the dominant tree at first, while an *Acacia* is the dominating tree of the ultimate or climax forest.

THE GNETALES AND THEIR AFFINITIES.—During recent years a large literature has accumulated around this remarkable group of Gymnosperms. The morphology of the reproductive structures in the three genera—*Gnetum*, *Ephedra*, *Welwitschia*—has now been worked out in considerable detail, but the result has been, on the whole, simply to emphasise their isolated position among Gymnosperms, living and fossil, as well as the sharp differences between the three genera, which should be regarded as constituting three distinct families, if not orders (cohorts). Lignier and Tison have recently published two papers on the group (*Ann. Sci. Nat. Bot.; Compt. Rend. Ac. Sci. Paris*). In the first paper they point out that, although the group has no fossil representatives, the recent thorough study of the three genera has provided facts for various generalisations. In *Welwitschia* the male and female cones have an essentially similar organisation; in the middle fertile region each bract bears in its axil a flower comprising five whorls of organs. In the male flower the two lower whorls are reduced to scales, sometimes with reduced vascular bundles; the third whorl bears the pollen-sacs (synangia); the fourth and fifth constitute an abortive four-carpelled ovary, which most botanists have regarded as the integument of the ovule; the latter is, according to Lignier and Tison, reduced to the nucellus. In the female flower the lowest whorl is usually absent, but is sometimes represented by two very small bracts, or by two vascular bundles in the cortex of the cone axis; the second whorl is absent, owing to the compression of the flower between this axis and the bract; the third becomes a winged envelope of the fruit; the fourth and fifth constitute the ovary which, as in the male flower, contains a single ovule reduced to the nucellus, but fertile. According to this ingenious interpretation, which the authors apply also to the flowers of *Gnetum* and *Ephedra*, the structure which has hitherto been regarded as an integument, with a prolonged and more or less trumpet-like opening in some cases, is considered to be an ovary with style and stigma. In their second paper the authors elaborate their views, according to which the Gnetales are primitive Angiosperms, though retaining various characters of Gymnosperms, and showing reduction of the flower such as precludes the idea that they are actually in the direct line of descent of the Angiosperms. They suggest that the Gnetales should be placed beside the catkin-bearing families—the "Amentiferae'—which may be regarded as a branch coming from the base of the Angiosperm trunk, and that perhaps the Amentalian branch has come off from this Gnetalian branch.

CHEMISTRY.

By C. AINSWORTH MITCHELL, B.A. (OXON), F.I.C.

CHEMISTRY AND THE WAR.—One of the first effects of the war has been to show us how dependent we have become upon other countries for our supplies of chemical products. Most of our drugs of synthetic origin are derived from German sources, and, as yet, we possess few facilities for supplying the want. Take, for example, the coal-tar product saccharin, which is largely used as a substitute for sugar. The supplies still available in this country are very limited, and will probably be exhausted long before the plant for manufacturing it in England can be erected.

Again, the dyeing industry is already feeling the pinch caused by the stoppage of importations of German dyestuffs, for only a relatively small proportion of aniline dyes is made in this country.

Other directions in which British industries will suffer from this scarcity are to be found in the manufacture of soap, where there will be a lack of potash for soft soaps, and in the photographic industry, which obtains most of its chemicals from abroad.

Several committees have already been formed to consider and advise as to the best means of supplying the chemical wants of various British industries. One of these has been appointed by the Board of Trade, another by the Society of Chemical Industry, and a third by the London Chamber of Commerce, and they include among their members leading chemical manufacturers, experts in the various industries affected, and the principals of technical colleges. Moreover, arrangements are being made to utilise in this country the patent chemical processes of countries with which we are at war.

In the field of pure chemistry, research will suffer considerably through many chemists being called to active service with the armies, and this will apply more especially to France and Germany, where conscription affects all below a certain age. It is doubtful whether many of the chemical journals in those countries will appear regularly, and, in fact, some have already stopped publication.

Apart from the deficient supply of pure chemicals, the work of the research chemist in this country will be handicapped by the want of glass apparatus, flasks, and so on. The best glass for the purpose is that made in Jena, while our supply of cheap flasks is largely derived from Bohemia. It remains to be seen whether the glass manufacturers in this country and America will be in a position to fill the gap.

APOREINE AND ITS SALTS.—An alkaloid with characteristic properties has been isolated by Dr. V. Paveis from the poppy, *Papaver dubium*, and is described in the *Gazzetta Chim. Ital.* (1914, XLIV, 398). This alkaloid, to

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which the name of "aporeine" has been given, has a composition agreeing with the formula, $C_{18}H_{16}NO_2$, and forms crystals which melt at 88° to 89° C., yielding a greenish-yellow fluorescent liquid. A distinctive property of the alkaloid is that when dissolved in certain solvents it shows a bluish fluorescence, closely resembling that of quinine salts. It combines with acids to form salts, and yields a sulphate which melts at 70° to 75° C., and when exposed to air and light decomposes, forming a red-brown powder.

DETECTION OF CASTOR SEEDS.—A biological method of detecting the presence of castor seeds in oil-cakes used as feeding stuffs for cattle is described by Messrs. Lander and Geake (*Analyst*, 1914, XXXIX, 292). It is based upon the fact that an extract of the seeds will yield a precipitate with antiricin serum in the presence of ricin, the active constituent of castor seeds. As a confirmatory test, blood-corpuscles are thoroughly washed and suspended in salt solution, and the mixture treated with the extract. Mixtures of linseed, with ten per cent. or more of castor seed, cause rapid agglutination of the blood-corpuscles, but with smaller proportions the reaction is less pronounced. Proof that the agglutination is due to the ricin may be obtained by mixing equal quantities of the extract from the seeds with ordinary serum and with antiricin serum and adding to each the same amount of the blood-corpuscle suspension. If agglutination is checked in the antiricin mixture, the presence of ricin is indicated.

ENGINEERING AND METALLURGICAL.

By T. STENHOUSE, B.Sc., A.R.S.M., F.I.C.

CORROSION OF CONDENSER TUBES.—In a previous note the results of an investigation, by Dr. G. D. Bengough and Mr. R. M. Jones, on the causes of corrosion in condenser tubes were described. For the most part the results obtained gave experimental support to the views generally held by engineering chemists, but one conclusion arrived at by the investigators came as a great surprise to all. This was "that even under the most favourable conditions that can be devised to exhibit electro-chemical attack on brass by carbon and copper no such action takes place, and that in consequence the settling of particles on condenser tubes is not *per se* a cause either of dezincification or of any intense local complete corrosion inducing a pit." It may be observed here that in present-day practice a marine condenser almost always consists of a cylindrical casing containing a large number of brass tubes through which seawater is pumped, the steam being condensed on the outer surfaces of the tubes. The point in question has now been further investigated by Mr. Arnold Philip, the Admiralty Chemist, whose results are given in a paper presented to the Institute of Metals. Test pieces of condenser tube were placed in contact with coke in running seawater for sixty days, while other test-pieces, not in contact with coke and supported in different ways, were exposed for comparison in the same seawater for the same period. At the conclusion of the experiment the pieces in contact with coke were all badly corroded, while the others were little affected. Quantitatively the strips out of contact with coke gave a relative mean corrosion velocity varying from 1 to 1·7, according to the freedom with which the seawater was able to circulate around the test-pieces. Those in contact with coke gave a relative corrosion velocity of nearly twenty-five. As the author says, the accelerating effect of coke on corrosion long ago attained the status of an ancient and respected truism, and these results will without doubt cause engineers to return to their old belief on this point.

GEOGRAPHY.

By A. STEVENS, M.A., B.Sc.

EXPLORATION.—*The Geographical Journal* for September contains a comprehensive story of the work of the Australasian Antarctic Expedition by Sir Douglas Mawson. The account of the travels of the shore parties, and of the voyages undertaken by the ship "Aurora" is well illustrated by maps and photographs. There is added an outline of the scientific work, from which it is seen that, when the material collected has been completely studied and worked up, the Expedition will have made remarkably valuable contributions to several departments of science.

An expedition, equipped and led by Dr. Bruce, left Tromsö on July 24th, on the sailing ship "Pelikane," for a two months' sojourn in Spitsbergen. The programme includes surveying and hydrographic work, by Dr. Bruce's party in the inlets of the area, and geological work, by a party on the east coast of the mainland. In view of the commercial possibilities of Spitsbergen, the Expedition has a special interest.

THE STRENGTH OF THE EARTH'S CRUST.—Those who are interested in the larger Earth problems may be referred to a series of articles of great interest which are at present appearing in the *Journal of Geology* under the name of Mr. J. Barrell. The current part (Part VA) deals with the questions affecting the problem of Isostasy and Gravity Anomalies.

TYPES OF STREAM VALLEYS.—The same journal contains an analysis of certain types of stream valleys by Mr. J. L. Rich. The types are three, named in the article: (1) The Open Valley; (2) The Intrenched Meander Valley; (3) The Ingrown Valley. Valleys of the first type are approximately straight, or wind about in broad open curves. Their sides are straight, and the stream winds from side to side in large curves, which only in the earliest stages correspond with the curves of the valley. Valleys of the first type run in meanders, due to an earlier cycle of erosion, which have been sunk into the country rock. In the case of the third type the meanders may be inherited; but, as the stream sunk its channel, the meanders grew and expanded. The examples discussed are mainly American, and the three types respectively are exemplified by the Kanawha River, the Kentucky River (type 3 also), and the Elkhorn Creek. The author concludes that the forms of valleys are determined by the ratio of the rate of vertical to lateral cutting and to sweep. Predominant down-cutting gives rise to valleys of types 1 and 2, while predominant sweep gives type 3.

GEOLOGY.

By G. W. TYRRELL, A.R.C.Sc., F.G.S.

GENETIC CLASSIFICATION OF ROCKS.—Another method of classifying rocks on a genetic-geological basis is proposed by Mr. T. C. Crook in the current *Mineralogical Magazine*. He lays down two principles which should govern the grouping of rocks: (1) It should be made in accordance with a geological grouping of processes; (2) the grouping must be determined by the nature of the process which has conferred on the rock its type characteristics. A classification of geological processes is therefore a necessary preliminary to rock classification. Mr. Crook makes a twofold main grouping into (1) those processes originating in internal causes, and operating deep-seatedly in the Earth's crust, or from within outwards; and (2) processes of external origin operating superficially or from without inwards. It is not made perfectly clear whether only rock-forming processes are thus to be classified, or all geological processes, some of which do not involve rock formation. Furthermore, this classification, whilst geological in a sense, is not according to the nature of the process, but according to its location in the crust. This results in several anomalies in the detailed classification of rocks, which is as follows:—

I.—ENDOGENETIC ROCKS, formed by processes of internal origin, which processes operate deep-seatedly, or from

within outwards. High-temperature effects constitute the prevailing characteristic, and the water taking part as an agent is partly of magmatic origin.

(1) Igneous Rocks.
(2) Igneous Exudation Products :
  (*a*) Contact impregnations and metasomatised rocks, including pneumatolysised.
  (*b*) Hydrothermal vein rocks.
  (*c*) Solfataric deposits.
(3) Thermodynamically Altered Rocks, but unfused and unmodified by exudations.

II.—EXOGENETIC ROCKS, formed by processes of external origin, which processes operate superficially, or from without inwards. These rocks are formed at ordinary or comparatively low temperatures, and the water taking part in their formation is of atmospheric origin.

(1) Weathering residues.
(2) Detrital Rocks, comprising aeolian, alluvial, and marine sediments, loose or cemented.
(3) Solution Deposits, loose or cemented.

(i) Surface-solution deposits :
  (*a*) Organic deposits.
  (*b*) Inorganic deposits.

(ii) Descending-solution deposits :
  (*a*) Certain vein deposits.
  (*b*) Metasomatised rocks.

(4) Subaërial Plant Accumulations and their Products. A few critical remarks may be made on this scheme. It would appear that lavas are exogenetic rocks according to the above definition. For while the actual material is of deep-seated origin, the processes which give lavas their distinctive characters (textures indicative of rapid cooling, flow structures, vesiculation, etc.) operate superficially, and at ordinary or comparatively low temperatures, although the water involved is not usually of atmospheric origin. Then, too, the terms "endogenetic" and "exogenetic" are used with regard to the Earth's crust, and not, as in Grabau's classification, with regard to the nature of the process. This involves the appearance of vein rocks, formed essentially by the same process (crystallisation or precipitation from solution), in both main divisions of the classification, because the process in one case operates deep-seatedly, and in the other more or less superficially. Thus, indeed, comes about the non-appearance of the whole group of solution deposits in the division that contains igneous rocks, although both types are formed by essentially the same process, crystallisation or precipitation from solution. The actual nature of the process would appear to be more important in classification than its location in the crust, or the temperature and pressure at which it is carried on, or the nature of the vehicle or solvent involved. These occasion secondary and subsidiary differences between rocks, which may well give rise to subdivisions in the classification, but not to its main divisions.

THE IMPERIAL TRANS-ANTARCTIC EXPEDITION.—Mr. Alex. Stevens, M.A., B.Sc., the contributor of our Geography Notes, has been appointed geologist and geographer to the Shackleton Trans-Antarctic Expedition, and will shortly proceed to the Weddell Sea. Mr. Stevens, who is a graduate of Glasgow University, is well qualified on both geological and geographical sides. He obtained his B.Sc. in geology with special distinction, and served a year as Demonstrator in the Geological Department, subsequently being appointed Assistant to the Lecturer in Geography at the University of Glasgow.

It is noteworthy that both the geologists appointed to the Shackleton Expedition—Mr. J. Wordie, B.Sc., now Demonstrator in Petrology at the University of Cambridge, and Mr. Stevens—received their geological training in the Geological Department of the University of Glasgow.

METEOROLOGY.

By WILLIAM MARRIOTT, F.R.MET.SOC.

GULLS KILLED BY HAIL.—In the August number of *British Birds* it is stated that an extraordinary destruction of gulls and other sea birds occurred at Teesmouth on July 2nd, as the result of a thunderstorm, which was accompanied by the fall of hail and lumps of clear ice. The bodies of three hundred gulls were counted within a distance of three-quarters of a mile, exclusive of those by the side of the breakwater.

WIND DIRECTION AND RAINFALL.—Mr. H. J. Bartlett read a paper before the Royal Meteorological Society on "The Relation between Wind Direction and Rainfall." This was a discussion of wind and rain records at the four observatories of the Meteorological Office—viz., Valencia, Aberdeen, Falmouth, and Kew—for the ten-year period 1901–10. He showed that a large proportion of the total rainfall falls with winds in the south-east and south-west quadrants, except in the case of Aberdeen, where the amount in the north-west quadrant is relatively high. The greatest amounts at Kew and Falmouth are with a south-west wind, respectively twenty-two and twenty-eight per cent. At Aberdeen the south-east wind brings the highest amount, twenty per cent.; while Valencia receives thirty per cent. with south, twenty per cent. with south-east, and fifteen per cent. with the south-west wind during the year. At each observatory there are two months during the year when the proportion of rain occurring normally in one or more quadrants diminishes considerably. For Valencia, Falmouth, and Kew this feature is strongly marked in June and September; while for Aberdeen, where it is less obvious, the months are May and November.

LIGHTNING AND TREES.—Very little reliable information is available on the question of the liability of trees to be struck by lightning. Mr. W. R. Fisher, in his book on "Forest Protection," gives some particulars on the subject. He points out that all species of trees are liable to be struck by lightning, but oaks and other species with deep roots appear to be most exposed to this danger, perhaps on account of their roots forming better conductors to the moist subsoil than those of shallow-rooted species. In the *Revue des Eaux et Forêts* the results are given of fifteen years' experience in a forest composed as follows :—

	Oak.	Beech.	Spruce.	Pine.	Others.
Percentage of trees ...	11	70	13	6	...
Trees struck by lightning	159	21	20	59	20
Relative frequency ...	48	1	5	33	...

This agrees with the results obtained by Dr. Hess in the forests of Lippe-Detmold from 1874 to 1890. Local circumstances, such as proximity to lakes, dampness of soil, density of growth, healthy or unhealthy condition of trees, affect the question whether one species will be more liable to attack than another in any particular locality. Starchy trees (oak, poplar, maple, ash, elm) are more in danger from lightning than oily trees (beech, walnut, birch, lime). Damp soils conduct electricity well, but in dry places, when the lightning has reached the ground, it may be spread from root to root of neighbouring trees, and cause them to die in groups.

As all kinds of trees are more or less liable to be struck by lightning, one cannot too strongly urge persons not to seek shelter under a tree during a thunderstorm.

THE METEOROLOGICAL OFFICE.—From the Report of the Meteorological Committee for the year ending March 31st we learn that the Parliamentary Grant has been increased from £17,000 to £20,000, and that this has enabled the Committee to considerably improve the organisation of the Meteorological Office. An addition has been made to the staff by the appointment of several "junior professional assistants." By increasing their annual contribution to the

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Scottish Meteorological Society, the Committee have opened a branch "Meteorological Office" at Edinburgh, and also, by taking over from the Royal Cornwall Polytechnic Society the Meteorological Observatory at Falmouth, they have made it a "Weather Station."

The work of the Meteorological Office is carried on under the following divisions: Marine, Forecast and Storm Warning, Climatology and Statistics, Instruments, and Observatories.

Perhaps the work of the Office which interests most people is the issue of the 8.30 p.m. forecasts of the weather that appear in the next morning's newspapers. In checking the forecasts the weather is considered under the aspects: (1) Wind, its direction and force, and the sequence of its changes within the period of the forecast; (2) weather, state of the sky in respect of cloud, together with precipitation in its various forms; (3) temperature of the day and night and its sequence, as represented mainly by the maximum and minimum temperatures; and (4) fog. A forecast is regarded as successful if it has given a fair representation of the actual facts for the majority of the aspects, and unsuccessful if the aspects which were correctly anticipated were less than half. If all aspects of the facts are adequately indicated in the forecast, the mark of complete success is assigned to it. On this understanding the evening forecasts for 1913 gave the following percentage successes:—

	%		%	
January ...	92,	of which	67	were correct in all points.
February ...	91	„ „	58	„ „ „ „ „
March ...	88	„ „	58	„ „ „ „ „
April ...	86	„ „	52	„ „ „ „ „
May ...	94	„ „	62	„ „ „ „ „
June ...	96	„ „	70	„ „ „ „ „
July ...	95	„ „	75	„ „ „ „ „
August ...	91	„ „	77	„ „ „ „ „
September	86	„ „	65	„ „ „ „ „
October ...	89	„ „	67	„ „ „ „ „
November	88	„ „	65	„ „ „ „ „
December ...	86	„ „	57	„ „ „ „ „
Year ...	90	„ „	64	„ „ „ „ „

MICROSCOPY.

By F. R. M. S.

NEW MOUNTING MEDIA.—In the recently issued seventh edition of his "Microtomist's Vade Mecum," p. 247, Bolles Lee draws special attention to some new resinous media devised by Gilson and manufactured by Grübler. The ingredients are sandarac, salol, camphor, eucalyptol, paraldehyde, and propylic alcohol, but detailed formulae are not published. "Camsal" and "euparal" are the names coined to describe the mixtures. Though I hold very strongly that this method of procedure is undesirable, I have experimented with euparal, and find it a very excellent medium. Bolles Lee uses it with stained material, and finds that it gives him further cytological details; and if this is the experience of one who is so great an authority on mitotic figures, and at the same time so thoroughly versed in every known method of staining, it is clear that euparal should be brought to the notice of biologists in general; since mitosis is a phenomenon of primary importance in every branch of the subject. I have been using it lately for mounting radulae of Mollusca, and find it superior in many respects to the glycerin jelly usually employed. I have before commented in this column on the shortcomings of glycerin jelly, and therefore need not repeat the indictment. The best results are obtained when the preparations are well ringed with brown cement and gold size; otherwise many changes are liable to take place. Euparal has a rather higher refractive index, but gives excellent visibility to the radular structures; it is most easily applied; according to Lee it is permanent. The preparations are more favourable to the photomicrographer than those mounted in glycerin jelly, owing to the absence of internal reflections. Personally, I have found it extremely difficult to obtain a passable photograph of a *Pomatias* radula in glycerin jelly on account of the great thickness of some of the parts. Figure 358 (see page 368, *ante*) shows how well they can be seen in euparal. It may be strongly recommended to all microscopists who have to deal with structures having a refractive index very near to that of xylol balsam, until the chemists can provide us with a true synthetic balsam having a lower refractive index.

E. W. BOWELL.

III.—THE COMMON EARWIG (*Forficula auricularia*).—One of the most familiar types of insect life to be found in the garden and field is the well-known Earwig (*Forficula auricularia*), which can be discovered during the day, hidden amongst the buds, and it is interesting to note that a great dislike to this particular insect has existed for centuries. This arises from a belief that the insects creep into the ears of persons, who are in the habit of sleeping in the open air, and cause death. This idea is most absurd, and any entomologist can soon show that insects considerably smaller than any Earwig would have great difficulty in entering the human ear, and in nearly every case fail in its attempts.*

Another unworthy accusation is made by many people that Earwigs exist specially for the purpose of doing damage to our pet plants in gardens, and consequently all the buds and flowers which show ravages made upon them are assigned to these particular forms of insect life.

The question as to whether Earwigs are mainly carnivorous or herbivorous has been a vexed one for a long time, but evidence deduced from research into this problem points to the fact that the insect is a boon, and not a pest, in the garden. The late W. Wesche, in 1900, showed that, in mounting the whole insect for microscopical slides, the stomach was full of aphides and plant-lice in a more or less disintegrated condition, and also that Earwigs preferred dead insects to fruit or vegetables as food.†

The Earwig is placed in the order Orthoptera, of which the well-known Cockroach is also a prominent member. It is interesting to note that Linnaeus in his classification placed the Earwig amongst the Beetles (Coleoptera); and the reason for this was due to their resemblance in general appearance to the brachelytrous beetles.‡

The essential features of Earwigs show that they agree with orthopterous insects, and consequently they are now placed in that order, next to the Cockroaches. The most wonderful and interesting characteristic of Earwigs is shown in the female, and they stand out with Ants, Bees, and Wasps in this respect conspicuously, in the careful attention given to the eggs and young when hatched until the latter are able to look after themselves.*

This maternal instinct is very unusual in insects not included in the Hymenoptera, and was first noticed by De Geer in 1773, and later by de Kerville in 1907.‡

The writer of this article wishes to say that, much to his surprise, he has found very little is known about the Earwig from the microscopical standpoint, and, except for a few notes on the life-history published now and again in the various journals, this particular insect has received scant attention. He hopes by the following notes to promote a new interest, so that other workers will add further information.

As in the case of the Gnat (*Culex pipiens*)§, the life-history

* "Marvels of Insect Life," pages 73–77. † "KNOWLEDGE," Volume XXIII, 1900, page 64.

‡ *Proceedings of the South London Entomological and Natural History Society*, W. J. Lucas, 1912, pages 21–27.

§ "KNOWLEDGE," 1914, pages 309–13.

and habits of the common Earwig (*Forficula auricularia*) are very simple. The eggs are laid in winter or early spring, and in certain cases can be found in autumn, in small pits dug in the soil, about an inch below the surface, or in crevices between flowers, buds, or leaves.*

The Earwig (♀), with her maternal instinct, carefully covers the eggs with her body as a protection; and, if the eggs become scattered, she immediately sets to work gathering them together by means of her jaws.

In early spring the eggs hatch out, and the insect emerges as a fully formed Earwig, minus wings. It is interesting to note that the larval and pupal stages, so familiar in other forms of insect life, are absent in the case of Earwigs, and the young, as they emerge, are exact replicas of their parents (see Figure 359).

The young Earwig at first is almost transparent, but the colour gradations pass from pure white to deep yellow, and, finally, to dark brown, as found in the adult stages.

One authority states that the head is large and the antennae, also the callipers (see Figure 360), are of disproportionate length; but the photo-micrographs under the same magnifications as used for the perfect insect show the callipers are much smaller and weaker than those present in the adult. The young Earwig possesses the long antennae and perfectly formed legs as found in the adult insects; the segments of the abdomen vary according to the sexes, those of the female numbering seven, whilst the male number nine.†

The change in the young Earwig from the wingless to the winged form is produced by a series of moults, or ecdysis stages, numbering four, and it is only in the last moult that the wings appear.

The fully formed insects of both sexes are very similar in appearance, but the male can be easily distinguished from the female by examination of the shape of the ferocious callipers, or cerci, situated at the hinder end of the abdomen. In some species these callipers attain an enormous size, and even in Forficularia one variety possesses forceps, or callipers, twice the size of the common type known as *Forficula auricularia* var. *forcipata*.

The callipers of the ♀ Earwig are nearly straight, and curve symmetrically about the tips. On the inner edges can be seen irregular grooves, which resemble rough teeth: these enable the insect to move the eggs about, and also to unfold or fold the wings (see Figure 361).

The callipers of the ♂ Earwig are considerably larger than those of the ♀, and appear more formidable by reason of their strong curves and projecting portions near the base, which at this point is very wide. The irregularity of their inner surfaces is not as pronounced as in the ♀, but the curves of each portion show a great resemblance to claws (see Figure 362).

As for their use, this is very obscure, and a disturbed Earwig can be seen to bring over the hinder end of the abdomen as if the callipers were present for self-defence.

A pinch by them on the human skin shows that these weapons are quite incapable of producing any harmful effect, and there is no doubt that the main use of the callipers is to assist in wing folding or unfolding. Other species of Earwigs use their forceps as weapons of offence and for catching or holding their prey, seen very often in Shore Earwigs (*Labidura riparia*). Sopp suggests that the callipers are used for piercing plant tissues, to set free the juices, which can then be taken in as food. There is no doubt that the Common Earwig feeds on vegetable matter, but, as pointed out earlier, they find the most natural food in small insects. So to assume from this that the Earwig is a constant foe of the gardener is not only wrong, but without proof, for common evidence proves otherwise.

W. HAROLD S. CHEAVIN, F.R.M.S.

(*To be continued.*)

PHOTOGRAPHY.

By EDGAR SENIOR.

METHOD FOR PREPARING PYROGALLOL.—As "pyro," like most of the chemicals which are employed in photography, is chiefly manufactured on the Continent, a difficulty will no doubt be experienced for a time, at least, in obtaining a supply, as, owing to the existing situation, the usual sources will not be available. It may therefore be of interest to show how a solution of "pyro" for use as a developer may be quite easily and cheaply prepared from time to time by the photographer himself. It is now many years ago that Mr. B. J. Edwards advocated the use of glycerine with the pyrogallic developer, and Professor T. E. Thorpe pointed out that if this substance was used as a solvent for gallic acid, and the solution cautiously heated, there would be no difficulty in effecting its conversion into pyrogallol without any of those secondary products being formed which complicate the reäction and increase the expense of preparing the substance in a crystalline form. Further, it was found possible to obtain a theoretical yield, or seventy-five per cent., of the weight of gallic acid employed, as against thirty per cent., at the most by the old method. In the preparation of pyrogallol by this method a wide test-tube is employed, and into this is placed one hundred and fifty grains of dry gallic acid dissolved in one fluid ounce of pure glycerine; the tube is then closed by means of a loosely fitting cork, through which a thermometer passes with its bulb immersed in the liquid. The contents of the tube are then heated over a sand-bath to a temperature of 185° to 200° Centigrade, the latter limit never being exceeded. During the operation bubbles of carbonic-acid gas will be seen to escape from the liquid; it is therefore necessary to provide an outlet for this gas, either by cutting a notch in the cork or making a second perforation. The heat is continued for a period of about half an hour, or until the evolution of the gas ceases, when the operation is finished. The tube is then allowed to cool, after which the contents are poured out into thirty-three ounces of distilled water (or *cold* boiled water); a solution is thus obtained which contains rather more than three grains of pyrogallol in each fluid ounce—a strength which lends itself very conveniently to most formulae in use. It has been found that the images upon plates developed with solutions of pyrogallol prepared in this way were in no way different from those obtained by the use of an aqueous solution of crystallised pyrogallol as generally employed; while half an ounce of the mixture contained sufficient "pyro" to develop a quarter plate. In containing glycerine the developer resembles that recommended by Mr. B. J. Edwards, which at one time found much favour with many photographers. The images that have been developed with solutions of this kind, however, frequently contain a good amount of yellow stain, but this may be entirely removed by treatment after fixing and washing with the following clearing solution:—

EDWARDS' CLEARING SOLUTION.

Alum	1 oz.
Sulphate of Iron	3 ,,
Water	20 ,,
Sulphuric Acid...	¼ ,,

INDICATORS.—Every photographer finds it necessary at times to employ certain tests in order to ascertain whether a solution is acid, alkaline, or neutral, and for this purpose litmus paper is generally made use of; and, although this is very useful in some cases, its value generally has been considerably overrated; because it indicates the point of neutrality in many cases it is assumed to do so in all. The subject of indicators has, however, received a great deal of attention from chemists, with the result that, in addition to the solitary indicator (litmus) of the photographer, they

* "KNOWLEDGE," 1914, page 194. † *Transactions Entomological Society of London*, Volume I.

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have now at their command: Phenolpthalein, methyl orange, turmeric, rosolic acid, cochineal, lacmoid, and so on. The qualities that are most generally useful, however, in indicators are found to be present in comparatively greater perfection in phenolpthalein, methyl orange, and litmus than in the others. Such being the case, it may be of interest to point out the characteristics of these three indicators in respect of the chemicals employed by the photographer. With nitric, sulphuric, or hydrochloric acids any one of the three indicators may be employed, except when the base of neutralisation is ammonia, or ammonium salts are present, in which case phenolpthalein is valueless. With organic acids phenolpthalein is the only one of the three indicators which is reliable, except in the presence of ammonia or its salts, when it is useless; with oxalic, tartaric, and, to an extent, with acetic acid, litmus is reliable, so that with these acids it may be employed in place of phenolpthalein when ammonium salts are present. With citric acid, however, the end reäction is always obscure. With carbonic acid methyl orange is the only one of the three indicators to which the acid is neutral in the cold; while it is only in boiling solutions that this acid is neutral to litmus. Hence it is useless to attempt to neutralise an acid solution with an alkaline carbonate using litmus as an indicator. For the formation of the acid carbonates of sodium or potassium in cold dilute solutions, phenolpthalein is a useful indicator. With sulphurous acid, phenolpthalein is to be recommended as an indicator of the formation of the normal sulphite, while, on the other hand, methyl orange should be employed when it is desired to note the point of neutrality in the formation of the acid sulphite. It follows from this that when sulphite of soda in a strictly neutral condition is required for any photographic purpose, then phenolpthalein should be employed as an indicator. If, on the other hand, it is the acid sulphite which is desired, then methyl orange must be used as the indicator. Test-papers, which are, as a rule, much more convenient to the photographer than solutions for which they are used as substitutes, cannot, unfortunately, be satisfactorily prepared from either phenolpthalein or methyl orange, but we may employ turmeric paper in most cases where phenolpthalein is used; while lacmoid paper may replace methyl-orange solution in all cases where the latter is employed, being kept immersed in the solution for a minute or two, and such papers, when properly prepared and kept in good condition, will be found invaluable as indicators.

PHYSICS.

By J. H. VINCENT, M.A., D.Sc., A.R.C.Sc.

THE AUSTRALIAN MEETING OF THE BRITISH ASSOCIATION.—The opening address to the Section of Mathematics and Physics was delivered by Professor F. T. Trouton, M.A., Sc.D., F.R.S., President of the Section. After referring sympathetically to the loss which science has suffered by the death of Sir Robert Ball, Professor Poynting, Sir David Gill, and Mr. Sutherland, he congratulated the Universities of Australia and New Zealand on the large number of their past students who have enriched science by research, especially in subjects connected with radio-activity. The work of Rutherford and others had shown that the stores of energy in the atom were unlocked, and it became a question whether the energy involved in our motion through the luminiferous ether could not be tapped, "despite the ingenious theories of relativity which have been put forward to explain matters away." The readiness with which the doctrine of "Relativity" had been accepted was an exaggerated example of the catholicity of present-day science. Professor Trouton then went on with the main portion of his address, which is abstracted in the following paragraphs:—

ABSORPTION AND ADSORPTION.—Absorption is a process taking place throughout a volume, whereas adsorption occurs at a surface. If powdered glass be put into a solution of a salt some of the salt will leave the body of the liquid and adhere to the surface of the glass. This is a case of adsorption. Roughly speaking, the amount adsorbed increases with the strength of solution, and diminishes with rise of temperature; but many exceptions to these simple rules are found. It seems that the surface adsorbs the salt in two ways—by the solution getting stronger in the immediate neighbourhood of the surface and by a deposition of salt on the surface. The layer of extra strength of solution is exceedingly shallow, being only about 10^{-8} centimetres in depth. In certain cases of anomalous adsorption the solvent is adsorbed, and not the solvend, so that the layer of liquid in contact with the surface is weaker than the bulk of the solution. A well-known experiment in adsorption is to pour a solution of permanganate of potash through a filter of precipitated silica, when it will be seen that the first portions of the liquid to escape are almost free from colour. If the experiment be continued the liquid comes through unchanged, as the surface has taken up all the salt it will retain. In the case of anomalous adsorption the first portions coming through the filter are stronger than the original solution. This happens with the alkali chlorides, provided the strength is below a certain critical value dependent on the temperature.

OSMOSIS.—These investigations should throw light on osmosis, since this must occur across a surface covered with an adsorption layer, and the final condition is an equilibrium between the absorption of water by the solution and that by the membrane. A medium which will allow some substances, but not others, to pass through it is called a semi-permeable medium. The transmission of a liquid through a layer of such a medium or a semi-permeable membrane is called *osmosis*. The ideal semi-permeable membrane is one made of a material which will not absorb any salt from the solution, but only water; but such perfection is seldom found. If a semi-permeable medium, such as parchment paper, be immersed in a solution of sugar, it absorbs less water than if it had been placed in water only. Further, the stronger the solution, the less the water it takes up. The semi-permeable medium increases its volume when it takes up water by a greater amount than that of the water absorbed. The quantity of water absorbed increases with the hydrostatic pressure, and it is possible to increase the pressure until the medium takes up as much water from a solution as it would from pure water under atmospheric pressure. Thus a portion of the medium cannot be in equilibrium with water and solution under the same pressure; but if the medium can be arranged in a layer, so as to withstand pressure, the equilibrium may be attained by having the pressures different on the sides in contact with water and solution. The part of the medium in contact with the solution will be at the greater pressure, and the moisture throughout the medium is everywhere the same. The effect of the adsorption layer over the surface of the semi-permeable medium must be taken account of in the theory of osmosis. This may explain certain anomalies met with in the result of experiments on strong solutions. Experiments on absorption from solutions by solids are very difficult to carry out, but are practicable with a liquid medium. Experiments on these lines have been successfully performed, in which ether constitutes the absorbing medium and sugar in water the solution. By pressure ether can be made to take up the same quantity of water from a solution as it takes up from pure water at atmospheric pressure, and the pressure required to bring this about is identical with the experimentally determined osmotic pressure of the solution. The most interesting fact in connection with the subject of osmosis was discovered by van 't Hoff, who showed that the pressure in question is that due to a gas having the same number of molecules as those of the introduced salt. Thus the salt produces the same molecular bombardment as it would were it in the gaseous state. Professor Trouton

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concluded his address by a short discussion of the analogous case of the lowering of vapour pressure by the presence of a salt in water.

RADIO-ACTIVITY.

By ALEXANDER FLECK, B.Sc.

ATOMIC WEIGHT OF LEAD.—During recent months there has been published a number of interesting papers dealing with the atomic weight of lead found in uranium and thorium minerals. The idea that this lead was the product of atomic disintegration was put forward a number of years ago by Professor Boltwood, of Yale University. The probability of the truth of this suggestion was much increased by the discovery of the law governing the passage of radio-active elements through the Periodic Table, enunciated independently in its present form by Fajans and Soddy. This law showed that the final products of the uranium-radium, thorium, and actinium disintegration series should be elements chemically indistinguishable from ordinary lead. The accepted value of the atomic weight of ordinary lead is 207·1, while the law referred to above leads us to believe that lead derived from uranium should be 206, while that from thorium should be 208. The atomic weight of actinium is not known accurately, so it is impossible to predict that of the resulting lead. The results of the experimental determinations are as follows :—

Soddy and Hyman, experimenting on lead derived from thorite—a relatively simple mineral, chiefly composed of thorium silicate and almost free from uranium—found the value to be 208·4. T. W. Richards and M. E. Lembert, O. Honigschmidt and Mlle. St. Horovitz, and Maurice Curie all found that the lead from uranium minerals was lower than ordinary lead (206·4 to 206·6). All these results agree with the theoretical predictions mentioned above.

THE BRANCHING OF THE DISINTEGRATION SERIES.—The fact that the atom of an element can undergo an internal change, referred to as disintegration, as the result of which the atom assumes entirely new properties, produced a complete revolution in scientific thought. Yet that direct change is comparatively simple when compared with the branching of the disintegration series, shown by radium-C, thorium-C, and uranium. Thorium-C was the example first discovered. So far as we know at present, the process is that each atom of a homogeneous collection of thorium-C atoms has the choice of emitting either an α particle or a β ray. What action pulls the trigger to let off one or the other we do not know. Whatever the mechanism, it always happens that thirty-five per cent. of the atoms give off α rays, and that the remaining sixty-five per cent. give off β rays. In the case of radium-C it happens that only 0·03 per cent. give α rays, while 99·97 per cent. give β rays. Evidence has also been obtained by Marsden and Wilson that actinium-C likewise undergoes a dual disintegration. The case of uranium is unique. In all the above examples the atom has the choice of two different kinds of rays, but in this case the choice is between two β rays of different ranges, that is, that the quantity of energy liberated in the different modes is dissimilar. The chemical properties of the resulting products are in this case identical, but their stability is very different, and, as a consequence, these latter elements break up at very different rates.

ZOÖLOGY.

By PROFESSOR J. ARTHUR THOMSON, M.A., LL.D.

ANCESTRY OF DOMESTIC FOWLS.—As some doubt has been cast on the validity of Darwin's conclusion that the ancestry of domestic fowls is to be found in the Indian jungle fowl, it is satisfactory to note Mr. C. W. Beebe's statement: "After studying all four species of feral *Gallus* in their native haunts, as well as many examples of natural and artificial hybridising, and reviewing the evidence from all points of view, I can find no reason to attribute the ancestry of all varieties of our domestic fowls to other than the red jungle fowl of India, *Gallus gallus* (Linnaeus)."

FLYING CRUSTACEAN.—Dean C. Worcester reports the occurrence of "A Flying Crustacean" from the Philippines, but he has not caught it yet. It was translucent, rose from the sea somewhat sharply, and "flew" not more than two or three rods before dropping into the water again. It was about fifteen to twenty centimetres in length and somewhat shrimp-like. It was seen four times. The specimens invariably rose against the wind.

PRODUCTIVITY OF ORGANISMS.—Many estimates have been made of what would happen if organisms multiplied without let or hindrance. We came across a new one in Professor J. F. Abbott's excellent "General Biology" (Macmillans, 1914). "An ordinary mosquito hatching from the egg reaches maturity and lays her own eggs ten days afterward. A single female lays about four hundred eggs, half of which become females. If a single female should hatch on April 1st, and lay her quota of eggs ten days later, on July 1st, ninety days later, if all lived, the progeny would number 102,914,592,864,480,008,004,001 mosquitoes." We have not verified this.

SOCIAL EVOLUTION AMONG PENGUINS.—Dr. Levick has made a fine study of the Adélie Penguins (*Pygoscelis adeliae*), and gives one much food for reflection. Two facts stand out among many. The first is the custom of forming "crèches" for the chicks when these reach a certain age, in this way. When the chicks are young they are easily fed by one parent at a time. The hen sits and the cock goes down to the sea to fill his crop with Euphausid Crustaceans. He returns, and the chicks are fed. After some fussing, the hen surrenders the task of incubation to her mate, and goes down to the sea; and so it goes on, in regular alternation. But as the chicks grow bigger they require more food, and the turnabout method of collecting this is inadequate. So the parents "pool" their chicks, and form "crèches" which are under the charge of a few old birds inclined to paedagogics. The young are educated a bit, and protected from the intrusive Skuas and the "hooligan" males, who are even worse. The other exhibition of sociality that gives one pause is a kind of "drilling," which was seen only once. The Penguins assembled in bands, thousands strong, and exhibited remarkable orderly movements, just like soldiers at drill. Dr. Levick suggests that this may correspond to the "massing" of birds like Starlings before the autumnal migration.

GALL-FORMING CRAB.—Mr. F. A. Potts has made some very interesting observations on *Hapalocarcinus*, a genus of small crabs, the females of which pass the greater part of their lives confined in small cavities in coral colonies. The young female probably commences her sedentary life by settling down in a notch at the apex of a recently divided branchlet. She is at this period a small flat creature, little more than a millimetre in carapace length. The initial modification of the growth of the coral is probably due to the mere mechanical effect of the continued presence of the crab. The branches, instead of remaining cylindrical, broaden out. They then approximate above and at the sides, thus partially enclosing a chamber. Eventually, a larger second chamber is formed on the top of the first, and the crab passes into this just before fertilisation, when the ovary begins to grow rapidly. Water enters and leaves the gall by numerous small apertures formed by the incomplete closure of what was at first a wide slit. The crab lives on the "dwarf-plankton," which is drawn in with the respiratory current. Mr. Potts discovered the minute free-living male, which seems to visit the females while the gall is still open. Soon after a stock of sperm has been secured, the gall closes up—so far that the visits of other males are prevented. The female lays brood after brood of eggs, which develop to the zoaea stage, and then leave the gall by the small openings.

XUM

THE FACE OF THE SKY FOR NOVEMBER.

By A. C. D. CROMMELIN, B.A., D.Sc., F.R.A.S.

TABLE 46.

Date.	Sun. R.A.	Sun. Dec.	Moon. R.A.	Moon. Dec.	Mercury. R.A.	Mercury. Dec.	Venus. R.A.	Venus. Dec.	Jupiter. R.A.	Jupiter. Dec.	Saturn. R.A.	Saturn. Dec.	Uranus. R.A.	Uranus. Dec.	Neptune. R.A.	Neptune. Dec.
Greenwich Noon.	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m	°
Nov. 4	14 35·2	S.15·2	3 36·5	N.24·5	15 1·0	S.18·3	16 39·4	S.27·7	21 5·3	S.17·7	6 8·5	N.22·3	20 41·6	S.19·0	8 10·3	N.19·7
,, 9	14 55·1	16·7	8 5·5	N.23·2	14 37·5	14·9	16 39·7	27·3	21 7·1	17·5	6 7·6	22·3	20 42·0	18·9	8 10·2	19·7
,, 14	15 15·4	18·1	12 19·6	S. 5·2	14 22·6	12·2	16 35·7	26·6	21 9·2	17·4	6 6·6	22·3	20 42·4	18·9	8 10·2	19·7
,, 19	15 36·0	19·3	17 24·7	S. 27·9	14 24·6	11·8	16 27·8	25·5	21 11·5	17·2	6 5·4	22·3	20 42·9	18·9	8 10·0	19·7
,, 24	15 57·0	20·4	22 10·7	S. 11·3	14 39·9	13·1	16 17·0	24·0	21 14·2	17·0	6 4·0	22·3	20 43·5	18·8	8 9·8	19·7
,, 29	16 18·3	S.21·4	1 48·4	N.15·8	15 2·9	S. 15·2	16 5·1	S. 22·2	21 17·0	S.16·8	6 2·5	N.22·3	20 44·1	S.18·8	8 9·5	N.19·7

TABLE 47.

Date.	Sun. P	Sun. B	Sun. L	Moon. P	Jupiter. P	Jupiter. B	Jupiter. L_1	Jupiter. L_2	Jupiter. T_1	Jupiter. T_2
Greenwich Noon.	°	°	°	°	°	°	°	°	h. m.	h. m.
Nov. 4	+ 24·1	+4·0	135·4	−13·4	−18·7	+0·1	64·2	124·2	0 25 *m*	8 35 *m*
,, 9	23·1	3·4	69·5	+10·7	18·8	0·1	132·8	154·7	6 14 *e*	5 41 *e*
,, 14	21·9	2·9	3·5	+22·1	19·0	0·1	201·4	185·1	6 30 *m*	6 55 *m*
,, 19	20·4	2·3	297·6	+ 4·0	19·2	0·2	269·9	215·5	2 29 *e*	4 0 *e*
,, 24	18·8	1·7	231·7	−19·2	19·4	0·2	338·4	245·8	0 36 *e*	3 10 *e*
,, 29	+ 17·0	+1·0	165·8	−20·1	−19·6	+0·2	46·8	276·1	0 53 *m*	4 24 *m*

P is the position angle of the North end of the body's axis measured eastward from the North Point of the disc. B, L are the helio-(planeto-)graphical latitude and longitude of the centre of the disc. In the case of Jupiter, System I refers to the rapidly rotating equatorial zone, System II to the temperate zones, which rotate more slowly. To find intermediate passages of the zero meridian of either system across the centre of the disc, apply to T_1, T_2 multiples of $9^h\ 50^m{\cdot}6$, $9^h\ 55^m{\cdot}8$ respectively.

The letters *m*, *e*, stand for morning, evening. The day is taken as beginning at midnight.

THE SUN is moving southward but with slackening speed. Its semi-diameter increases from 16′ 8″ to 16′ 15″. Sunrise changes from $6^h\ 55^m$ to $7^h\ 44^m$; sunset from $4^h\ 32^m$ to $3^h\ 53^m$.

MERCURY is an evening star till 7th, when it transits the Sun (transit visible in England) and becomes a morning star. Semi-diameter 5″ at transit, diminishing to 3″ at end of month; at elongation, 20° west of Sun, on 24th.

THE TRANSIT OF MERCURY.—The first contact takes place at $9^h\ 57^m\ 15^s$ *m* on November 7th, 156° from N. Pt. of Sun towards East. $2^m\ 14^s$ later the whole planet will be on the Sun. It will be at its least distance from the Sun's centre (10′ 31″ south) at $0^h\ 3^m\ 22^s$ *e*. It will begin to pass off the Sun at $2^h\ 7^m\ 16^s$ *e*, 255° from N. Pt. towards E, and will be entirely off $2^m\ 14^s$ later. The times given are for the Earth's centre: they will be slightly affected by parallax. The planet will not be visible on the Sun without telescopic aid, and for the benefit of those unaccustomed to view the Sun it is as well to point out the necessity of a proper dark glass, or else the use of the projection method, an enlarged image of the Sun being thrown through the telescope on to a white screen placed behind it. This method enables several observers to work simultaneously. The screen should be shielded from direct sunshine by a large piece of cardboard, in which a round hole is made, to fit on the telescope tube.

The transit is visible in Europe, Africa, South America, and parts of Asia and North America.

The last transit occurred in November 1907, the conditions of visibility in England being almost the same as in the present one. The next will be in May, 1924, followed by one in November, 1927.

The observations of chief importance during the transit are to accurately time the external and internal contacts, and to make micrometric measures of the size of the planet's disc. This last requires a fairly large instrument, equatorially mounted.

Some observers have noted during transit a bright spot on the black disc, and an aureole surrounding it. These were probably optical illusions; but there is no harm in being on the alert for any abnormal appearances.

VENUS is an evening star till 27th, when it passes Inferior Conjunction and becomes a morning star. Illumination diminishes from one-sixth of disc to zero. Semi-diameter increases from 24″ to 32″. The fact of its declination being south of the Sun impairs the conditions of observation for northern observers. The inferior conjunction is 4 of the 8-year periods after the 1882 transit, and is therefore a fairly close one, 1° 37′ south of the Sun's south limb.

THE MOON.—Full $2^d\ 11^h\ 49^m$ *e*. Last quarter $10^d\ 11^h\ 37^m$ *e*. New $17^d\ 4^h\ 2^m$ *e*. First quarter $24^d\ 1^h\ 39^m$ *e*. Apogee $2^d\ 8^h$ *e*. Perigee $17^d\ 4^h$ *m*. Apogee $29^d\ 11^h$ *e*, semi-diameter 14′ 43″, 16′ 45″, 14′ 44″ respectively. Maximum librations $4^d\ 7°$ S., $11^d\ 7°$ E., $18^d\ 7°$ N., $22^d\ 8°$ W.

XUM

The letters indicate the region of the Moon's limb brought into view by libration. E., W. are with reference to our sky, not as they would appear to an observer on the Moon (see Table 48). Attention is called to the unusually large libration on 22nd, of which advantage should be taken to observe the West limb.

MARS is practically invisible.

JUPITER is an evening star, in Capricornus, 28′ North of ι Capricorni on 30th. Polar semi-diameter, 18″. In quadrature with Sun on 7th; ½° N. of Moon on 23rd.

Configuration of satellites at $6^h\ 30^m$ *e* for an inverting telescope.

JUPITER'S SATELLITES.

Day.	West.	East.	Day.	West.	East.
Nov. 1	3 ○ 124		Nov. 16	1 ○ 24 3●	
,, 2	1 ⊙		,, 17	2 ○ 134	
,, 3	42 ○ 13		,, 18	12 ○ 43	
,, 4	41 ○ 3 2●		,, 19	4 ○ 132	
,, 5	4 ○ 132		,, 20	431 ⊙	
,, 6	432 ○	1●	,, 21	432 ○ 1	
,, 7	4321 ○		,, 22	43 ○ 2	1●
,, 8	43 ○ 12		,, 23	413 ○ 2	
,, 9	41 ○ 2	3●	,, 24	42 ○ 13	
,, 10	24 ○ 13		,, 25	412 ○ 3	
,, 11	12 ○ 43		,, 26	4 ○ 132	
,, 12	○ 1324		,, 27	314 ○ 2	
,, 13	321 ○ 4		,, 28	32 ○ 14	
,, 14	32 ⊙ 4		,, 29	3 ○ 4	2● 1●
,, 15	3 ○ 124		,, 30	31 ○ 24	

The following satellite phenomena are visible at Greenwich, all in the evening:—$2^d\ 5^h\ 7^m\ 26^s$ III. Ec. R., $9^h\ 12^m\ 13^s$ IV. Tr. E., $9^h\ 54^m\ 17^s$ II. Tr. I.; $4^d\ 9^h\ 45^m\ 3^s$ II. Ec. R.; $5^d\ 8^h\ 12^m\ 9^s$ I. Tr. I., $9^h\ 31^m\ 38^s$ I. Sh. I., $9^h\ 57^m\ 9^s$ III. Tr. I., $10^h\ 29^m\ 26^s$ I. Tr. E.; $6^d\ 4^h\ 39^m\ 37^s$ II. Sh. E.; $5^h\ 31^m\ 13^s$ I. Oc. D.; $9^h\ 8^m\ 23^s$ I. Ec. R.; $7^d\ 4^h\ 58^m\ 25^s$ I. Tr. E.; $6^h\ 17^m\ 54^s$, I. Sh. E.; $9^d\ 5^h\ 31^m\ 5^s$, III. Ec. D.; $9^h\ 8^m\ 49^s$, III. Ec. R.; $11^d\ 6^h\ 3^m\ 53^s$ IV. Ec. R., $6^h\ 44^m\ 26^s$ II. Oc. D.; $12^d\ 10^h\ 8^m\ 20^s$ I. Tr. I.; $13^d\ 4^h\ 26^m\ 30^s$ II. Sh. I., $4^h\ 39^m\ 10^s$ II. Tr. E., $7^h\ 15^m\ 31^s$ II. Sh. E., $7^h\ 27^m\ 12^s$ I. Oc. D.; $14^d\ 4^h\ 37^m\ 33^s$ I. Tr. I., $5^h\ 56^m\ 25^s$ I. Sh. I., $6^h\ 54^m\ 58^s$ I. Tr. E., $8^h\ 13^m\ 47^s$ I. Sh. E.; $15^d\ 5^h\ 32^m\ 27^s$ I. Ec. R.; $16^d\ 4^h\ 12^m\ 5^s$ III. Oc. D., $7^h\ 50^m\ 59^s$ III. Oc. R.; $16^d\ 9^h\ 32^m\ 41^s$ III. Ec. D.; $18^d\ 9^h\ 25^m\ 12^s$ II. Oc. D.; $20^d\ 4^h\ 28^m\ 50^s$ II. Tr. I., $7^h\ 2^m\ 32^s$ II. Sh. I., $7^h\ 18^m\ 19^s$ II. Tr. E., $9^h\ 24^m\ 7^s$ I. Oc. D.; $21^d\ 6^h\ 34^m\ 58^s$ I. Tr. I., $7^h\ 52^m\ 16^s$ I. Sh. I., $8^h\ 52^m\ 30^s$ I. Tr. E; $22^d\ 4^h\ 21^m\ 52^s$ II. Ec. R., $7^h\ 27^m\ 44^s$ I. Ec. R; $23^d\ 4^h\ 38^m\ 42^s$ I. Sh. E., $8^h\ 22^m\ 3^s$ III. Oc. D.; $27^d\ 7^h\ 3^m\ 56^s$ III. Sh. E., $7^h\ 9^m\ 38^s$ II. Tr. I., $7^h\ 40^m\ 2^s$ IV. Oc. D.; $28^d\ 8^h\ 33^m\ 12^s$ I. Tr. I.; $29^d\ 5^h\ 51^m\ 25^s$ I. Oc. D., $7^h\ 0^m\ 31^s$ II. Ec. R.; $30^d\ 4^h\ 17^m\ 5^s$ I. Sh. I., $5^h\ 20^m\ 39^s$ I. Tr. E., $6^h\ 34^m\ 41^s$ I. Sh. E.

Eclipses will take place to the right of the disc in an inverting telescope, taking the direction of the belts as horizontal.

SATURN is a morning star, in Gemini. Stationary on October 15th. Polar semi-diameter 9½″. Major axis of ring 46¾″, minor 20½″. Angle P−6°·2.

Eastern elongations of Tethys (every 4th given) $8^d\ 5^h\cdot0\ m$, $15^d\ 6^h\cdot2\ e$, $23^d\ 7^h\cdot4\ m$, $30^d\ 8^h\cdot5\ e$; of Dione (every 3rd given) $8^d\ 0^h\cdot9\ m$, $16^d\ 5^h\cdot8\ m$, $24^d\ 10^h\cdot8\ m$; of Rhea (every 2nd given) $1^d\ 1^h\cdot0\ m$, $10^d\ 1^h\cdot8\ m$, $19^d\ 2^h\cdot5\ m$, $28^d\ 3^h\cdot1\ m$.

For Titan and Japetus E., W. stand for East and West elongations, I for Inferior (North) conjunction, S. for Superior (South) conjunction. Titan $5^d\ 2^h\cdot2\ m$ I, $8^d\ 10^h\cdot9\ e$ W., $12^d\ 10^h\cdot9\ e$ S., $17^d\ 1^h\cdot3\ m$ E., $21^d\ 0^h\cdot1\ m$ I., $24^d\ 8^h\cdot8\ e$ W., $28^d\ 8^h\cdot8\ e$ S; Japetus $3^d\ 3^h\cdot6\ e$ E., $23^d\ 11^h\cdot8\ e$ I.

URANUS is an evening star in Capricornus, 1½° North of Moon on 22nd.

NEPTUNE is a morning star, coming into a better position for observation. Stationary on 3rd.

COMETS.—See "Notes on Astronomy" in this number. Delavan's Comet promises to be an easy object to the naked eye.

METEOR SHOWERS (from Mr. Denning's List):—

Date.	Radiant. R.A.	Radiant. Dec.	Remarks.
	°	°	
Nov. 1 ...	43	+ 22	Slow, bright.
,, 2 ..	58	+ 9	Slow, bright.
,, 10-12 ..	133	+ 31	Very swift, streaks.
,, 14-16 ..	150	+ 22	Leonids, swift, streaks.
,, 16-28 ...	154	+ 41	Swift, streaks.
,, 20-23 ...	63	+ 23	Slow, bright.
,, 17-23 ...	25	+ 43	Andromedids, very slow, trains.
,, 25-Dec. 12	189	+ 73	Rather swift.
,, 30 ...	190	+ 58	Swift, streaks.

In the cases where the radiant is stated to be active for several months, there is a difference of opinion as to whether it can be regarded as a single shower or a combination of several.

TABLE 48. Occultations of stars by the Moon visible at Greenwich.

Date.	Star's Name.	Magnitude.	Disappearance. Time.	Disappearance. Angle from N. to E.	Reappearance. Time.	Reappearance. Angle from N. to E.
1914.			h. m.	°	h. m.	°
Nov. 6 ...	BD + 27°·880	7·0	—	—	8 59 *e*	301
,, 6 ...	136 Tauri...	4·6	9 49 *e*	54	10 48 *e*	291
,, 7 ...	BAC 1918..	6·1	1 53 *m*	98	3 16 *m*	267
,, 8 ...	39 Geminorum	6·2	3 46 *m*	156	4 36 *m*	231
,, 8 ...	BAC 2506	6·3	—	—	8 51 *e*	298
,, 8 ...	BAC 2514	6·0	8 23 *e*	100	[illegible]9 17 *e*	272
,, 8 ...	BD + 24°·1755	6·8	—	—	11 18 *e*	308
,, 9 ...	BD + 24°·1806	7·0	—	—	6 0 *m*	345
,, 9 ...	η Cancri	5·5	—	—	9 25 *e*	211
,, 13 ...	79 Leonis..	5·5	7 24 *m*	145	8 31 *m*	290
,, 14 ...	Wash. 785	7·6	—	—	4 8 *m*	261
,, 29 ...	BD + 16°·247	6·4	7 29 *e*	62	8 47 *e*	234
,, 30 ...	Wash. 176	6·7	8 48 *e*	50	[illegible]; —	—
,, 30 ...	ε Arietis (double)...	4·6	9 0 *e*	125	9 40 *e*	183

From New to Full disappearances take place at the Dark Limb, from Full to New reäppearances.

DOUBLE STARS AND CLUSTERS.—The tables of these given two years ago are again available, and readers are referred to the corresponding month of two years ago.

VARIABLE STARS.—The list will be restricted to two hours of Right Ascension each month. The stars given in recent months continue to be observable (see Table 49).

TABLE 49. NON-ALGOL STARS.

Star.	Right Ascension.	Declination.	Magnitudes.	Period.	Date of Maximum.
	h. m.	°		d.	
R Arietis	2 11	+24 ·7	7·3 to 13·2	186·66	Sept. 22.
o Ceti (Mira)...	2 15	−3 ·3	2·0 to 9·6	331	Oct. 7 (Min^{m})
R Ceti...	2 22	−0 ·6	7·5 to 12·8	166·88	Sept. 21.
R Trianguli	2 32	+33 ·9	5·3 to 12·0	265·4	Sept. 20.
R Persei	3 25	+35 ·4	7·9 to 13·8	210·3	Sept. 22.

Minima of Algol $4^{d}\ 5^{h}\cdot7\ m$, $7^{d}\ 2^{h}\cdot5\ m$, $9^{d}\ 11^{h}\cdot4\ e$, $12^{d}\ 8^{h}\cdot2\ e$, $15^{d}\ 5^{h}\cdot0\ e$, $24^{d}\ 7^{h}\cdot4\ m$, $27^{d}\ 4^{h}\cdot3\ m$, $30^{d}\ 1^{h}\cdot1\ m$. Period $2^{d}\ 20^{h}\ 48^{m}\cdot9$.

Principal Minima of β Lyrae November $5^{d}\ 0^{h}\ e$, $18^{d}\ 10^{h}\ m$. Period $12^{d}\ 21^{h}\ 47^{m}\cdot5$.

SOLAR DISTURBANCES DURING AUGUST, 1914.

By FRANK C. DENNETT.

Observations were made on the Sun every day during August, with the exception of the 8th. On four (5th, 9th, 28th, and 31st) the disc appeared free from disturbance, and on twelve (1st to 4th, 6th, 7th, 10th to 12th, 27th, 29th, and 30th) only faculae were seen. The longitude of the central meridian at noon on August 1st was 309° 37′.

No. 24.—A fine spot, first seen on the 13th, within the north-eastern limb, followed by a faculic area. From the 16th until the 22nd some small pores clustered round its eastern half; none, however, were very persistent. There were also some penumbral extensions, which, on the 21st, reached a maximum diameter of thirty-six thousand miles; but the usual diameter of the spot was twenty-six thousand miles, and the length of the group forty-five thousand miles. On the 18th the umbra was almost broken into three by very pale bridges. A bright tongue projected into it from the east, 19th till 21st. The northern part of the umbra was quite cut off on the 23rd until the 25th. The spot was last seen on the 26th.

No. 25.—A group of pores of varying configuration seen from the 16th until the 18th in a faculic area. The greatest length attained was sixty thousand miles. The rear component was much the largest on the 17th.

No. 26th.—A pair of tiny pores visible from the 15th until the 19th.

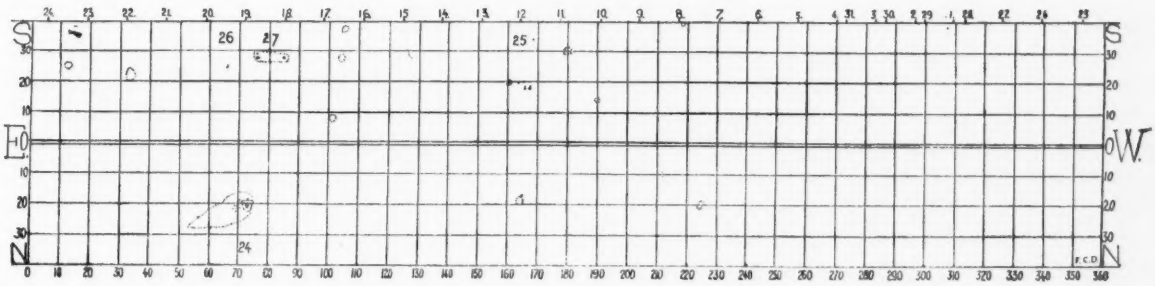
No. 27th.—A small spot and group of pores, some sixty-six thousand miles in length, a little south-west of the last, seen on the 23rd and 24th.

Faculae were observed near the north-western limb on August 18th (164°, 19° N.) and 27th; north-eastern on 7th, 10th, 26th, and 29th (224°, 20° N.); eastern on 11th till 13th (101°, 9° S.); south-western on 1st (32°, 22° S., and 13°, 26° S.), 10th, 11th (219°, 40° S.), 12th till 16th (190°, 14° S., and 180°, 30° S.), 23rd and 25th; south-eastern on 2nd till 4th, 6th, 10th, 11th (104°, 28° S.), 14th, 16th, and 30th; and in the south polar area on the 21st.

During the eclipse on August 21st No. 24 was a beautiful object. Its dark umbra was, however, markedly less dark than the advancing rugged limb of the Moon, which presently covered it. It was of large size, but the spectroscope showed comparatively little disturbance.

Our chart is constructed from the combined observations of Messrs. John McHarg, J. C. Simpson, E. E. Peacock, and F. C. Dennett.

DAY OF AUGUST, 1914.



REVIEWS.

ASTRONOMY.

The Observer's Handbook for 1914.—Edited by C. A. CHANT. 72 pages. 1 map. 6-in. × 4¼-in.

(Toronto: The Royal Astronomical Society of Canada. Price 25 cents.)

This useful handbook, the sixth of the series, contains much that is required by the practical astronomer, especially the large body of amateurs. The positions of the planets, Sun, and Moon day by day or during the month are given for 1914, also Jupiter's satellites, together with notes on the various objects in the constellations. There is not much about the variable stars.

F.

Annuaire de L'Observatoire Royal de Belgique, 1914.—By G. LECOINTE.

Les Progrès récents de l'Astronomie (*V, Année* 1911).—By PAUL STROOBANT. 506 pages. 5 plates. 7-in. × 4½-in.

(Bruxelles: Hayez.)

This series has now been continued for a number of years, and the contents include something of the nature of a very condensed English, French, or German nautical almanac, and is intended for use in Belgium. After the usual daily information for the Sun, Moon, planets, and stars in 1914—which occupy one hundred and thirty-four pages—there are chapters on "Le Globe Terrestre," "Les Marées," "Le Magnétisme Terrestre," "L'Électricité Atmosphérique," Tables of Refraction, Rising of the Sun, and so on; Conversion of Mean and Sidereal Time, and Time to Arc, Elementary Ideas on the Measure of Time, Explanation of the Ephemerides and Tables, the Legal Time in different countries, and the Distribution of Time by Wireless Telegraphy: these include one hundred and seventy-one pages.

The rest of the *Annuaire* (two hundred and one pages) consists of a necessarily brief review of "Les Progrès récents de l'Astronomie, V, année 1911," by P. Stroobant. Arranged under various subjects, such as the Sun, Planets, and Comets (pages 53*a* to 88*a*), the progress in stellar astronomy in 1911 is summed up on pages 88*a* to 173*a*; this is followed by a chapter by G. van Biesbroeck on "Calcul approché des Occultations." A complete list of the publications from the Royal Observatory of Belgium and an Index end the book.

This annual summary, by M. P. Stroobant, must involve a great deal of reading and work. It is a useful epitome, and would be rendered of even more use if a more detailed index were added.

F. A. B.

The Riddle of Mars, The Planet.—By C. E. HOUSDEN. 70 pages. 3 plates and other illustrations. 8½-in. × 5½-in.

(Longmans, Green & Co. Price 3/6 net.)

The author has worked out an ingenious scheme, from an engineering point of view, to explain the cause of the markings on Mars; with such a system of irrigation or conveyance of water from the melting polar caps—the Coolgardie system being a simile, the adaptation of the Martian method, or the converse—it is claimed that everything observed on Mars is satisfactorily accounted for. The arguments in support of his contentions are specious ones, and based on earthly suppositions. Chapter I relates to the colour changes observed on Mars; in Chapter II some comparison is made of the Earth with Mars; Chapters III to V explain how terrestrial engineers would plan the contract for the Martian water supply; Chapter VI deals with the horse-power required (about two thousand five hundred million horse-power, to be obtained from oil or the Sun); the seventh chapter sums up the author's conclusions: but the riddle remains unsolved. The book is well printed and illustrated. Speculative astronomy has its use in whiling away an hour or hours, whether of the author's or reader's time; but could not the time be far better spent? If some desire their imaginative powers livened up, books such as this may do it, and, if not producing any permanent good, are far less harmful than literary novels. Jules Verne's books no doubt served their purpose at the moment.

F. A. B.

CHEMISTRY.

Nucleïc Acids.—By W. JONES, PH.D. 118 pages. 9¼-in. × 6½-in.

(Longmans, Green & Co. Price 3/6 net.)

This book follows the course of its predecessors in the series of monographs of bio-chemistry in aiming at a critical digest of researches on the subject that have appeared in scientific journals all over the world. Many of these are contradictory in their conclusions, and in such cases the author skilfully balances the evidence on each side. Much confusion with certain groups of proteins has grown up about the nucleïc acids, which are distinctive nitrogenous compounds contained in the nuclei of plant and animal cells, and in his opening chapter the author takes pains to show the points of relationship and difference between the two classes of bodies. In the first part of the book the chemical properties and derivatives of the nucleïc acids derived from thymus gland and from yeast cells are described, while the second part discusses the physiological properties (including their formation and decomposition in the organism) of the two classes of compounds. The outline of analytical methods and a good bibliography add greatly to the value of the monograph as a practical handbook in the laboratory.

C. A. M.

GEOGRAPHY.

Industrial and Commercial Geography.—By J. RUSSELL SMITH. 914 pages. 244 figures. 8½-in. × 6-in.

(Constable & Co. Price 15/- net.)

The aim of this book is finely expressed in the first sentence of the preface. It is "to interpret the earth in terms of its usefulness to humanity." The book is divided into two parts, the first dealing with industry, the second with commerce, in relation to geographical conditions. The result has been to produce a volume of absorbing interest, not only in its subject-matter, but in the angle from which it views certain world-wide geographical relations, and the simple and charming style in which it is written. It is a book of a calibre and quality which lifts it high above the ruck of geographical works. The first part of the book is the longer, occupying more than two-thirds of its bulk. It treats each industry in turn, and explains its localisation and extent in relation to the environmental conditions. It exhibits the dependence of the various industries on climate, topography, and population, and shows how the tremendous expansion of our environment, effected by development of means of transport, has modified human activities. A typical instance of this is the abolition of the old "starving time" (April and May) in England, because we are no longer dependent on our own harvest to feed our people, but have food materials coming in abundantly from all parts of the world. The author leads us to hope that the food problem of the world will easily be solved by giving more scientific attention to the great undeveloped resources residing in its at present unused or little-used vegetable productions.

The latter third of the book shows that commerce depends on three factors: racial differences, differences in the stage of industrial development, and differences in the resources of the various lands. The last is the most important, since resources depend on topography, soil, moisture, nearness to sea, and temperature—factors independent of man. The differences arising from racial culture and the stage of

industrial development constantly tend to be levelled up amongst the various nations by the progressive equalisation of culture and trade. Further chapters describe and explain the location and origin of the trade routes of the world, the development of trade centres, the balance of trade in relation to industrial development, and the influence of geographical factors on the commercial policy of nations. The book, in fact, treats of the borderland between geography and economics, and leaves one with the impression that the "dismal science" must have greatly changed its character since the days of Ruskin. It is impossible to overpraise the care and thoroughness with which the work is done. It must have involved an enormous amount of delving into the little-worked mines of blue-book literature and trade journalism. The publisher and printer are also to be congratulated on the excellent appearance of the book and its freedom from typographical errors.

G. W. T.

GEOLOGY.

Geological Excursions round London.—By G. MACDONALD DAVIES, B.Sc., F.G.S. 156 pages. 4 plates. 20 figures. 1 map. 7½-in. × 5-in.

(T. Murby & Co. Price 3/6 net.)

London is not exactly an ideal centre for geological excursions. Natural exposures are rare, and the geologist has to depend on the chances of artificial exposures, which tend to be impermanent in the neighbourhood of a great city. Moreover, only Mesozoic and Kainozoic rocks are exposed within fifty miles of the city. Igneous rocks are absent, and the Palaeozoic floor is only accessible through deep borings. Hence the many geologists whose work centres in and about London are especially indebted to Mr. Davies for producing this handy work, which will enable them to employ their spare time to the best geological advantage. The description of twenty-six pleasant geological walks in the London basin, the Weald, and beyond the Chilterns, is prefaced by a concise account of the stratigraphical geology of the south-east of England. The descriptions are accompanied by sections and some excellent photographs. A geological map of the south-east of England, on the scale of about eighteen miles to the inch, is provided.

G. W. T.

MINERALOGY.

Minerals and the Microscope.—By H. G. SMITH, A.R.C.Sc., B.Sc., F.G.S. 116 pages. 12 plates. 7½-in. × 5-in.

(T. Murby & Co. Price 3/6 net.)

This little book is intended to aid the beginner in microscopical petrography, and gives instruction in the use of the microscope, the recognition of minerals by means of their optical properties, and the use of these observations for the determination of rocks. The diagnostic characters of thin sections of minerals in ordinary transmitted light, in reflected light, with the lower Nicol inserted, and between crossed Nicols, both in parallel and in convergent polarised light, are described in as simple language as the technical character of the subject matter permits. The author has done remarkably well in achieving simplicity and lucidity in this difficult optical subject, notwithstanding great limitation in space and paucity of illustrations. He has omitted to state that in determining the angle of extinction the maximum value of readings made on several different crystals should be taken.

A useful synopsis of the microscopic characters of the common rock-forming minerals follows. The chapter describing methods of determining refractive index of isolated fragments might well have been expanded to deal with the characters of isolated mineral fragments in general, since, in the investigation of sands and clays, the clastic fragments appear to the student very different from the uniform thin sections with which he is accustomed to deal. The book closes with a brief chapter of hints on the microscopic characters of thin sections of rocks. This work will be of great use to students of elementary petrology, and its value is enhanced by an excellent series of photomicrographs of thin sections of minerals.

G. W. T.

SPINNING TOPS.

An Elementary Treatment of the Theory of Spinning Tops and Gyroscopic Motion.—By HAROLD CRABTREE, M.A. Second edition. 193 pages. 5 plates and numerous diagrams. 9¼-in. × 6-in.

(Longmans, Green & Co. Price 7/6 net.)

Ever since the appearance of Professor Perry's popular monograph on Spinning Tops opened the eyes of so many readers to the wealth of scientific import that underlies the principle of the favourite toy of childhood, it has been fully realised what an enormous field of interest and mystery the subject involves—a field covering alike the movements of solar systems, the revolutions of molecules, and probably the very qualities which constitute the apparent but questionable "solidity of matter." Mr. Crabtree's treatise, modestly called "an elementary treatment" of such phenomena, is therefore welcome as throwing considerable light on the seemingly paradoxical behaviour of spinning and gyrating bodies. The second edition contains additional articles on the practical applications of gyroscopic principles in the monorail cars of Brennan and Schilowsky, and also the gyro compass, a not less wonderful development of modern science. It need hardly be said that to an entirely unmathematical mind the mysteries of the spinning top must remain an insoluble problem, for there is no other way of elucidating them than by mathematical symbols; but by the aid of such equations, formulae, and graphic representations as are provided in these plainly written chapters an intelligent comprehension of the subject becomes possible to anyone who has had some training in elementary dynamics, while the introductory chapters, which make little demand upon the mathematical faculties, are in themselves full of fascinating interest to the less qualified reader. The whole subject is scientifically dealt with, and, at the same time, is lucidly expounded, with the aid of excellent plates and diagrams. A graceful sonnet to Dr. W. H. Besant at the commencement of the volume incidentally belies the notion that exact science and a true poetic sense are in any way incompatible.

C. E. B.

CORRESPONDENCE.

THE LONGEST DAY.

To the Editors of "KNOWLEDGE."

SIRS,—I shall feel obliged if you will kindly inform me which is the longest day of the year, June 21st or June 22nd, as there seems to be some uncertainty about it amongst a good many people.

WORTHING. P. J. D.

If your correspondent wishes for the exact mathematical formula for the longest day it is:

When

$$\cos 15^\circ . t = - \tan l . \tan 23^\circ 28'.$$

t = the length of the morning (or evening).

l = the latitude of the place.

$23^\circ 28'$ = the Sun's greatest north declination or position in the heavens, *i.e.*, at the time of the summer solstice.

By changing the sign before the tan l the *shortest* day is determined.

In simpler form I will put it thus:

SUN ENTERS CANCER.

			h.	m.	
*1908	.....	June 21	8	19	=8 p.m.
1909	.....	,, 21	14	6	=22nd, 2 a.m.
1910	.....	,, 21	19	49	=22nd, 8 a.m.
1911	.....	,, 22	1	35	=22nd, 2 p.m.
*1912	.....	,, 21	7	17	=21st, 7 p.m.
1913	.....	,, 21	13	9	=22nd 1 a.m.
1914	.....	,, 21	18	55	=22nd, 7 a.m.
1915	.....	,, 22	0	29	=22nd, noon.
*1916	.....	,, 21	6	24	=21st, 6 p.m.

[The astronomical day begins at noon, and we run to 24h: a.m.'s and p.m.'s are a great nuisance.]

The year is 365¼ days long. Leap years come in for the odd hours once in four years. The Sun entering Cancer practically coincides with the Sun's great north declination; hence the longest day, which is at present nearly always on June 22nd. In Leap years it will thus be on June 21st, and may even (or in a few years' time) be on June 21st in the year *after* Leap years.

In nearly every book on astronomy published within the last seventy-five years, there is a singular absence of any direct reference to this expression, though the question has often been set in examination papers.

OXFORD. F. A. B.

NOTICES.

SECOND-HAND BOOKS.—A catalogue, issued by Messrs. W. Heffer & Son, of second-hand books consists of one hundred and eighty-six pages, of which several are devoted to books on Botany, Chemistry, Biology, and Zoölogy.

THE ZOÖLOGICAL SOCIETY.—The additions to the Zoölogical Society's menagerie during July were two hundred and seventy-seven in number, and included a Lesser Kudu (presented by Mr. Arnold Hodgson), a Cape Ant-bear (purchased), two Canadian Beavers (born in the menagerie), and several birds and lizards new to the collection.

BIRKBECK COLLEGE.—We welcome the appearance of the Calendar of the Birkbeck College, which contains particulars of all the classes and teaching staff in the faculties of Arts, Laws, and Science, as well as details of the various societies established in the College, and results of recent examinations.

THE IRISH NATURALIST.—The August and September issues of *The Irish Naturalist* have been combined to form a special double number to deal with "the Opisthobranch Fauna of the Shores and Shallow Waters of the County Dublin." The author gives sixty-nine species of the molluscs in question, including forty-five nudibranchs, or sea-slugs.

EXTENSION LECTURES.—Once more we welcome the issue by the Manchester Microscopical Society of the list of extension lectures which are voluntarily given by members of the Society. The Honorary Secretary is Mr. R. Howarth, of 90, George Street, Cheetham Hill, Manchester, from whom details of the sixty-nine subjects offered can be obtained.

CONTINUOUS CURRENT ELECTRIC MOTORS.—A new list has reached our hands which describes some of the latest designs of machines, from 1·65 to 54 brake horse-power, which are manufactured by Messrs. Crompton & Company. These motors are constructed with a very liberal rating, and have a low temperature rise, with high efficiency and large overload capacity. They are designed for driving all classes of industrial machinery, and the list includes pipe-ventilated and drip-proof machines for dusty, damp, or wet situations.

PETROLEUM.—Messrs. Crosby Lockwood & Son announce for publication in the autumn a new book on the "Chemistry of Petroleum and its Substitutes," by Drs. C. K. Tinkler and F. Challenger, of the University of Birmingham. The increasing importance of petroleum has necessitated thorough scientific training of those concerned with the industry, and hitherto there has been no suitable book combining some technological matter with the purely theoretical and practical organic chemistry necessary to a comprehension of the methods employed. It will be remembered that the University of Birmingham has instituted a three years' course in Petroleum Mining.

THE NEED FOR PLANT PROTECTION.—A correspondent of the Glasgow *Evening Citizen* writes as follows: "Gathering orchids seems to be a Sunday diversion in England in some places. On a recent Sunday in Holland's Wood, Brockenhurst, I met a man with a bouquet of the lesser butterfly orchis of anything up to a hundred of this beautiful and delicate species, and I saw another man engaged in a similar quest. Forest gypsies are adepts at this game, and to them it is a good source of profit. It is a deplorable state of affairs, which, it is to be hoped, will soon be remedied. Meantime, those who encourage the traffic are surely more blameworthy than the gypsies."

THE BRITISH ASSOCIATION.—It is announced that the following members are proceeding from Australia to England, via Suez Canal, by the P. & O. steamer "Malwa," which is expected to arrive in London on October 2nd: Mr. and Miss Beaven, Dr. C. I. and Mrs. Bond, Professor W. S. Boulton, Mr. and Miss Challenor, Dr. F. D. Chattaway, Professor F. J. Cole, Professor W. E. Dalby, Dr. W. H. Eccles, Mr. W. D. Eggar, Professor J. J. Findlay, Sir T. H. Holland, Dr. C. W. Kimmins, Mr. G. W. Lamplugh, Mr. and Mrs. Laurie, Mr. F. S. Macauley, Professor B. Moore, Mr. R. B. Newton, Professor, Mrs., and Miss Poulton, Dr. A. O. Rankine, Professor T. B. Wood.

UNDERGRADUATES OF THE GLASGOW UNIVERSITY.—The Principal of the University of Glasgow asks us to convey to undergraduate students, called to active service for their country, the assurance that the University of Glasgow will do what it can to safeguard their academic interests. The authorities whom he has been able to consult agree with him in recommending that to such students every consideration should be extended which the Ordinances will permit. In relation to attendance at courses of instruction, to duration of study, to periods of notice required, and the like, account will be taken of a student's absence on military duty, so as, if possible, to ensure that his graduation shall not be unduly delayed.

NEW BOOKS.—In Messrs. Macmillan & Company's Autumn List, they announce the appearance of a life of Lord Avebury, by Horace Hutchinson. Under the heading of Anthropology is a General Index to Sir J. G. Frazer's "Golden Bough." We notice also "An Introduction to Field Archaeology, as illustrated by Hampshire," by Dr. J. P. Williams-Freeman; the first volume of "A Treatise on Embryology," edited by Walter Heape and written by Professor MacBride; "Stellar Movements and the Structure of the Universe," by Professor Eddington; and "Transpiration and the Ascent of Sap in Plants," by Professor Dixon.

In Messrs. Black's Autumn List we notice "Chemical Analysis," by George G. Gardiner; "Wireless Telegraphy," by A. B. Rolfe-Martin; and "Wild Life in Woods and Streams," by C. A. Palmer, to which the Rev. Charles A. Hall furnishes an Appendix on Mammals and Birds.

XUM